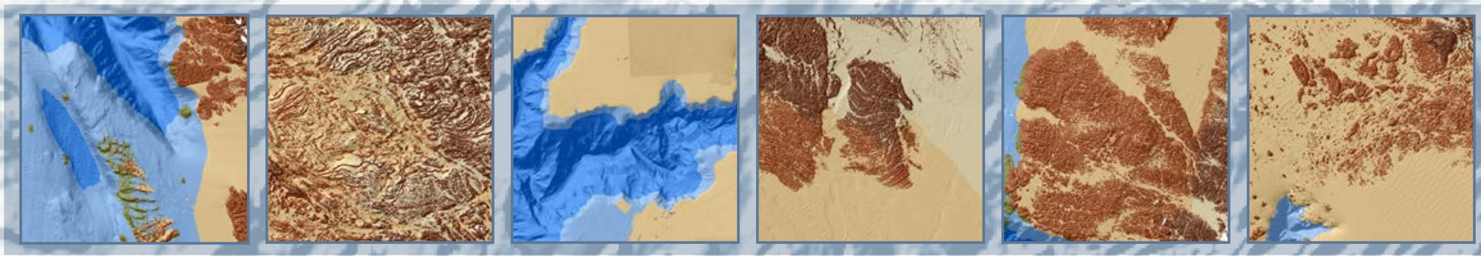
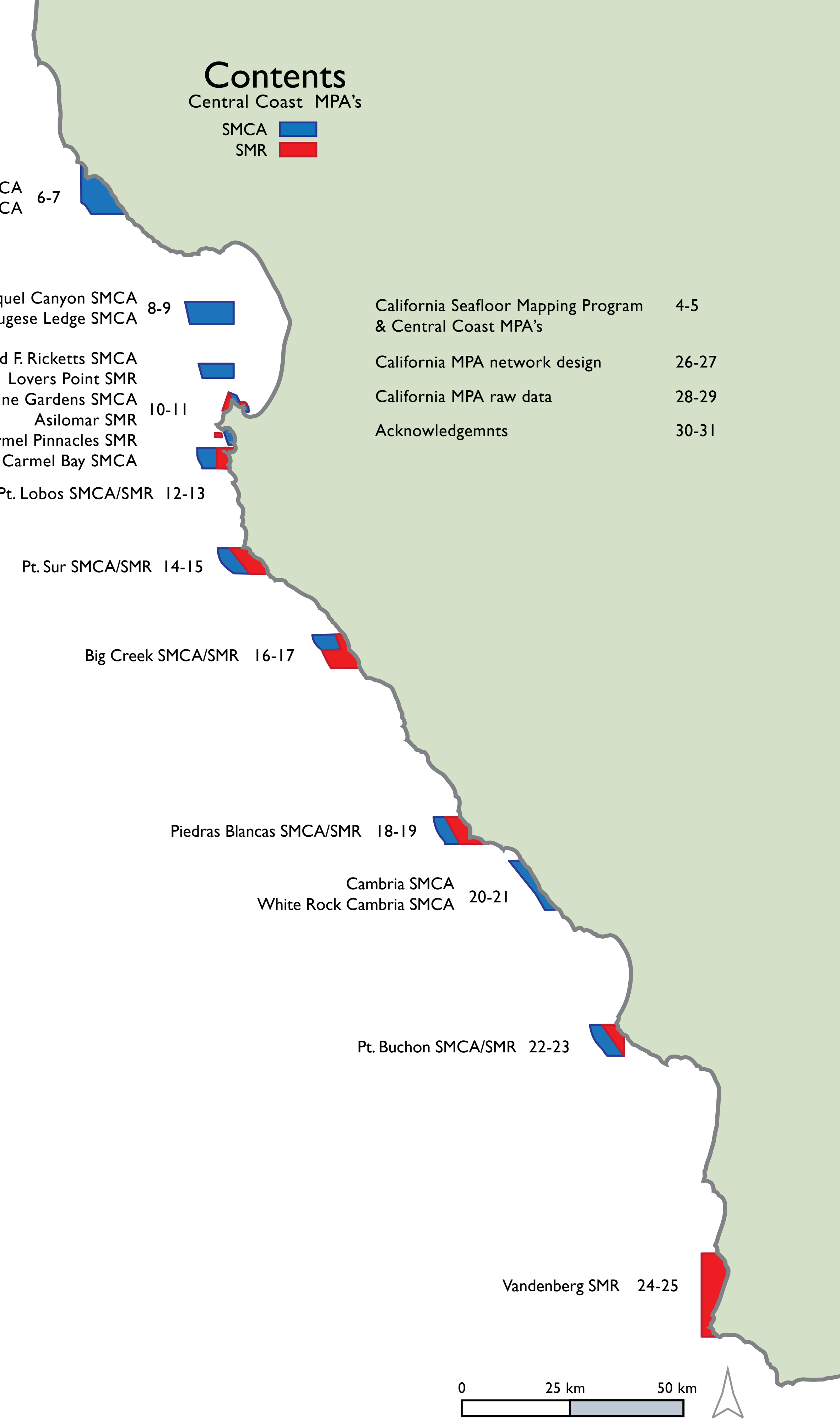


California Seafloor Mapping Program

Central Coast Marine Protected Areas

California Central Coast Marine Protected Areas

Contents



Carmel Bay

"…and some rin up hill and down dale, knapping the chucky stanes to pieces wi' hammers, like sa mony road-makers run daft. They say 'tis to see how the world was made!"

Sir Walter Scott, St.Ronan's Well, 1824

California Seafloor Mapping Program and Central Coast MPA's

The purpose of this publication is to present a general overview of the seafloor habitats found within each of the Marine Protected Areas (MPAs) comprising the Central Coast Region of California's State-wide MPA Network. The maps and habitat information presented are products of the California Ocean Protection Council's (OPC) California Seafloor Mapping Program (CSMP).

Initiated in 2005, the California Seafloor Mapping Program is the first comprehensive mapping of a state's entire territorial sea in our nation's history. The ultimate goal of CSMP is the creation of onshore and offshore habitat and geology maps. Funded largely by the OPC through State Proposition 84 bond funds, with additional contributions from NOAA, private industry, state and federal agencies, and NGO's; the CSMP was conducted by a collaborative team of experts from resource management agencies, private industry and academia. The products from the CSMP include a wide variety of digital map layers derived primarily from multibeam echo sounder bathymetry, sub-bottom profiling sonar, and video and still imagery data of the seafloor. The results and products from the CSMP include a wide variety of digital map layers derived primarily from multibeam echo sounder bathymetry, sub-bottom profiling sonar, video and still imagery data of the seafloor. These products are being made publically available through a variety of venues including: a comprehensive folio map series being created by the United State Geological Survey (USGS), incorporation into the GoogleEarth Globe, and as downloadable GIS data layers at the websites of the CSUMB Seafloor Mapping Lab, USGS and the National Geodetic Data Center (NGDC).

While the CSMP was launched to meet a diverse set of critical state marine management needs, including identifying hazards to navigation, assessing earthquake and tsunami risks, modeling coastal erosion and sea level rise, making wiser development decisions, exploring the potential for off-shore energy, as well as the basemap for applied and basic research; the driving force behind the CSMP has been California's Marine Life Protection Act (MLPA) and its mandate to create the nation's first Marine Protected Area (MPA) network. Because California's MPA network is required by law to capture representative amounts of regional seafloor bottom types (rocky and sedimentary habitats) within four depth zones (0-30m, 30-100m, 100-200m, and > 200m), the initial CSMP product development has focused on the classification and delineation of these basic seafloor habitat types within state waters. The MLPA adopted this approach because California's rich marine biodiversity is a direct result of the wide range of habitats found within state waters.

This mapping effort has been largely successful in completing the CSMP data acquisition along the mainland coast, with the exception of a critical data gap in the extreme nearshore where up until recently surf, kelp and rocky shoals precluded the use of conventional mapping methods. As a result, a significant portion of the shallow depth zone in many of the MPAs has not been mapped, but new techniques developed during the course of the CSMP now make it possible to fill this data gap (see page 26).

The CSMP also contributed to workforce development with dozens of California State University, Monterey Bay students trained in state-of-the-art seafloor mapping technology participating in CSMP data collection and map product creation. Many of the graduates now fill important marine spatial planning positions at state and national levels.

Here we provide descriptions and maps from the CSMP depicting the basic geology and MLPA habitats found in the MPAs of the Central Coast Region extending from the Año Nuevo State Marine Conservation Area (SMCA) in the north (see pages 6-7) to the Vandenberg State Marine Reserve (SMR) near Point Conception in the south (see pages 24-25). Following the maps we have highlighted some recent advances in science using CSMP data to understand how habitats are used by biological communities (pages 28-31).

GEOLOGY AND HABITAT OF THE CENTRAL COAST

The distribution of marine species is governed by gradients (e.g., temperature and depth), but also by the substrate distribution (e.g., rocks and sand). Thus, documenting the substrate and how it changes through time is just as vital to resource management as monitoring other parameters. The shallow geology (surface deposits and shallow rocks) and geomorphology (landforms and landscapes) of a region constitute the immutable background context for modern physical and biological processes.

While much of the geological context is unchanging over millennia, many physical variables evolve on a timeframe of direct interest to resource managers. Rocky regions can expand or contract as sand alternately buries or reveals the local bedrock crags. Submarine canyon processes sporadically disturb the canyon walls and floor. Strong currents continually rearrange the location of coarse and fine sand substrate on the shelf.

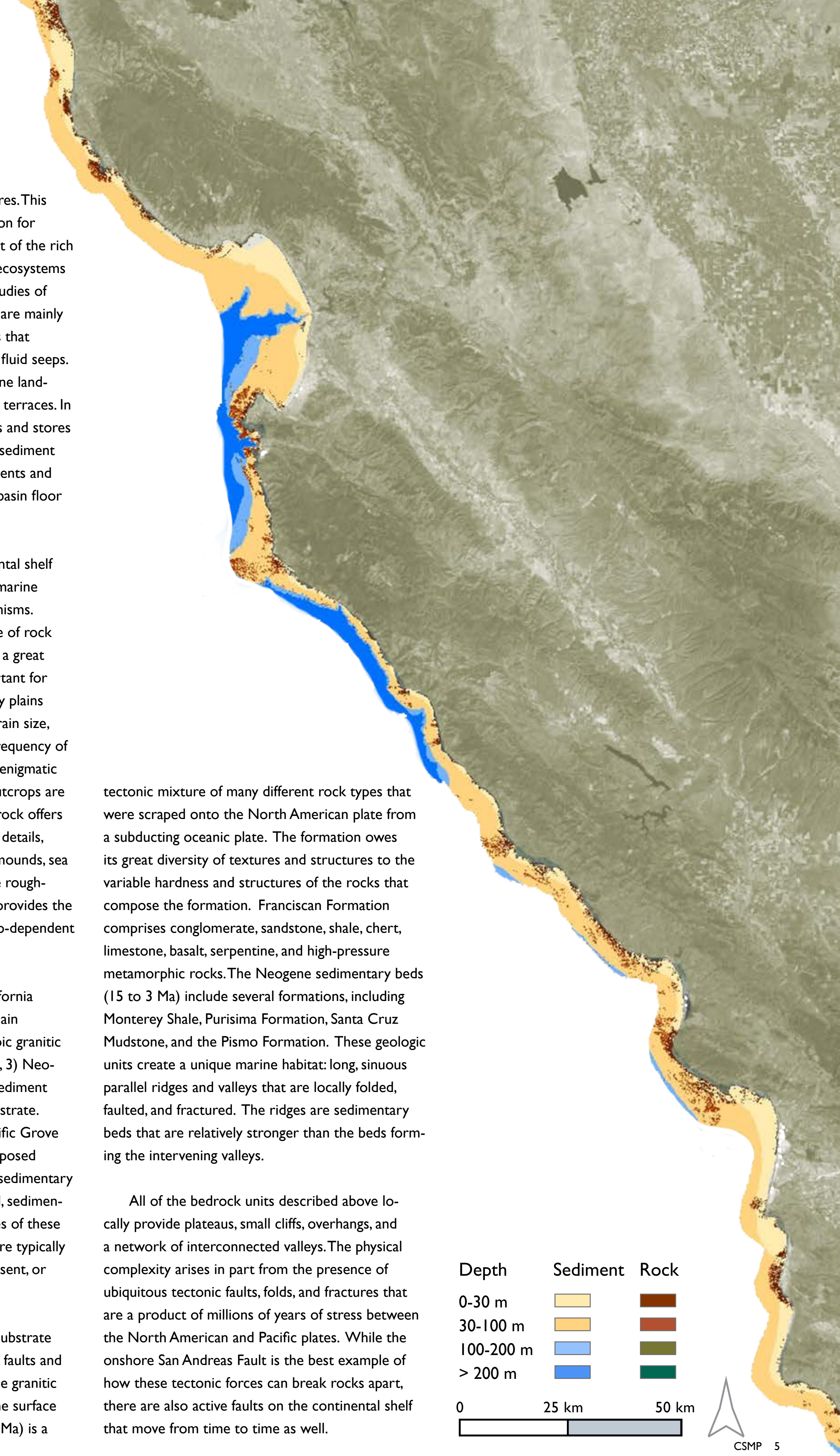
Prior to the CSMP, California's submerged continental shelf was generally regarded as a relatively flat, featureless surface cut by numerous deep submarine canyons. Now, with the remarkable seafloor detail unveiled by the CSMP and presented in this volume, California's continental shelf is revealed as a highly complex mosaic of diverse physical features. This new knowledge is providing the foundation for improved understanding and management of the rich diversity of marine habitats, species and ecosystems found along California's coast. Modern studies of canyon erosion suggest that the canyons are mainly cut and enlarged by submarine processes that include landslides, turbidity currents, and fluid seeps. Each canyon provides a range of submarine landscapes, including canyon walls, floors, and terraces. In general, the continental shelf accumulates and stores sediment, while the canyons provide the sediment pathway between shallow shelf environments and broad depositional settings on the deep basin floor located much farther offshore.

A closer look at the shallow continental shelf reveals much detail that is important to marine communities, species and individual organisms. The substrate can be divided into a range of rock types and sediment veneers that provide a great range of shapes and textures, each important for specific kinds of marine life. The flat sandy plains of the shallow continental shelf vary in grain size, presence and size of ripples and dunes, frequency of sediment transport, and the presence of enigmatic "rippled scour depressions." Bedrock outcrops are more geomorphically diverse. Hard bedrock offers a broad range of topography and surface details, including fractures, faults, cliffs, plateaus, mounds, sea mounts, parallel ridges, joints, and surface roughness. In shallow waters, bedrock locally provides the anchorage for broad kelp forests and kelp-dependent communities.

The shallow continental shelf of California shown in this publication includes four main substrate types: 1) Mesozoic and Cenozoic granitic rocks, 2) Mesozoic Franciscan Formation, 3) Neogene sedimentary beds, and 4) modern sediment cover that locally buries the bedrock substrate. Granitic rocks are exposed between Pacific Grove and Point Lobos; Franciscan rocks are exposed between Point Sur and San Luis Obispo; sedimentary rocks are exposed in many locations; and, sedimentary cover is ubiquitous. The geologic ages of these different formations, generalized below, are typically expressed as millions of years before present, or "mega annum," abbreviated "Ma."

Granitic rocks (80 Ma) form a hard substrate with an interconnected labyrinth of deep faults and fractures. The fractures form when brittle granitic rocks expand during their slow rise to the surface of the Earth. Franciscan Formation (100 Ma) is a tectonic mixture of many different rock types that were scraped onto the North American plate from a subducting oceanic plate. The formation owes its great diversity of textures and structures to the variable hardness and structures of the rocks that compose the formation. Franciscan Formation comprises conglomerate, sandstone, shale, chert, limestone, basalt, serpentine, and high-pressure metamorphic rocks. The Neogene sedimentary beds (15 to 3 Ma) include several formations, including Monterey Shale, Purisima Formation, Santa Cruz Mudstone, and the Pismo Formation. These geologic units create a unique marine habitat: long, sinuous parallel ridges and valleys that are locally folded, faulted, and fractured. The ridges are sedimentary beds that are relatively stronger than the beds forming the intervening valleys.

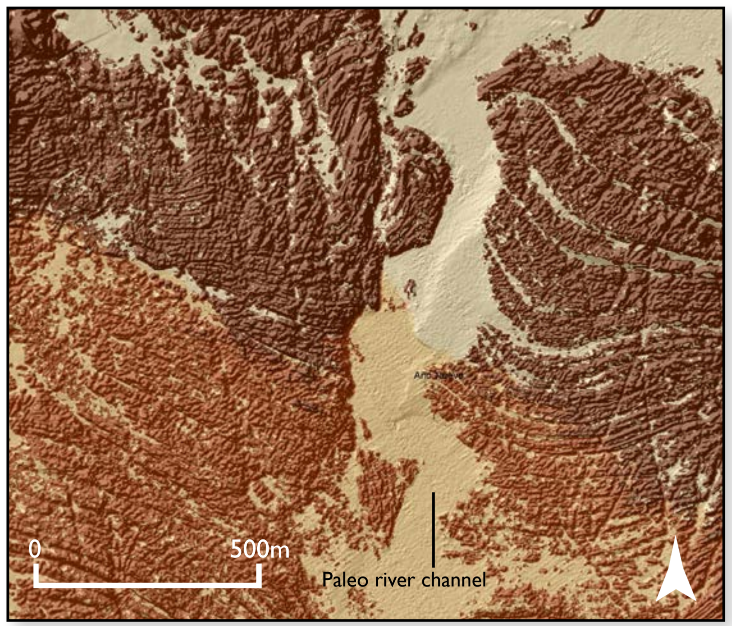
All of the bedrock units described above locally provide plateaus, small cliffs, overhangs, and a network of interconnected valleys. The physical complexity arises in part from the presence of ubiquitous tectonic faults, folds, and fractures that are a product of millions of years of stress between the North American and Pacific plates. While the onshore San Andreas Fault is the best example of how these tectonic forces can break rocks apart, there are also active faults on the continental shelf that move from time to time as well.



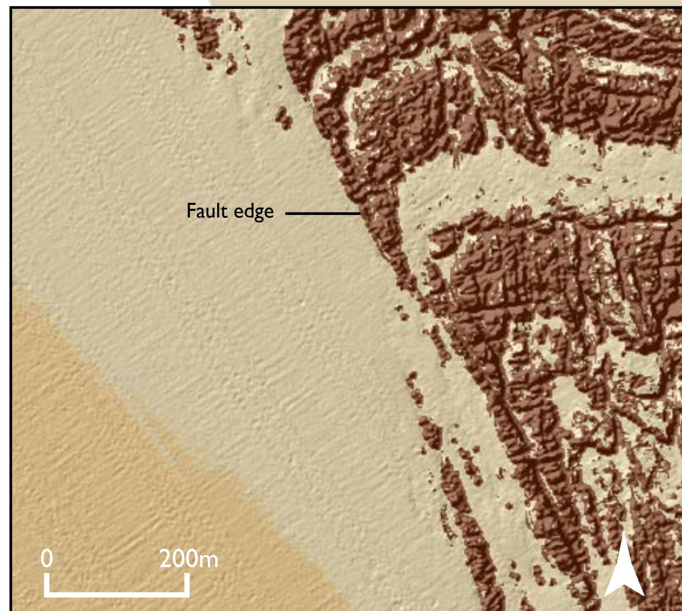
Año Nuevo/Greyhound Rock

SMCA

The Año Nuevo and Greyhound Rock SMCAs straddle active northwest-oriented faults of the North American/Pacific plate boundary. The seafloor substrate comprises thin-bedded Neogene sedimentary rocks and modern sediments. (A) Monterey Formation bedrock is folded, pervasively fractured and faulted. Small-scale habitat topography is dominated by long, wavy, low-relief (< 1m, < 3ft), parallel ridges and intervening crevasses. Sediment veneer is relatively featureless. (B) Highly-fractured Santa Cruz Mudstone outcrops provide less-distinct, low relief rock ridges blanketed by a thin sediment veneer. The straight southwestern edge of rock outcrop is a fault.



Ⓐ The Monterey Formation creates a complex habitat of wavy, low-relief, parallel ridges and crevices. Here the Monterey Formation is incised by a meandering paleo river channel formed when the continental shelf was exposed during a lower sea level stand.



Ⓑ The low relief Santa Cruz Mudstone habitat yields less distinct low rock ridges than the Monterey Formation (A). The sharp linear western edge of the rock/sediment transition is indicative of a fault.

Año Nuevo SMCA (28.7 Km^2)

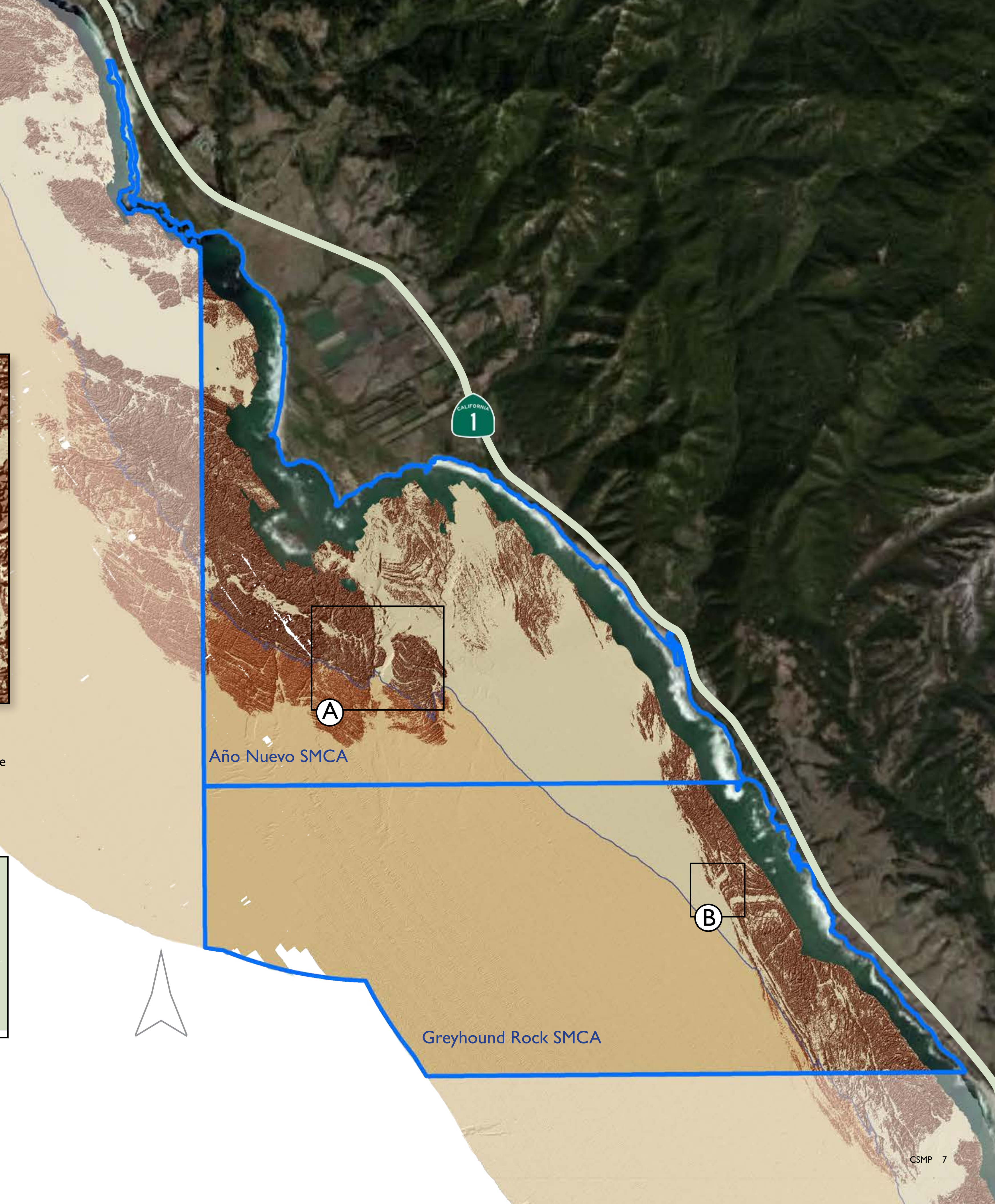
CSMP Data coverage - 22.2 Km^2

Depth	Sediment	Rock
0-30 m	57.9%	42.1%
30-100 m	67%	32.2%

Greyhound Rock SMCA (31 Km^2)

CSMP Data coverage - 28.2 Km^2

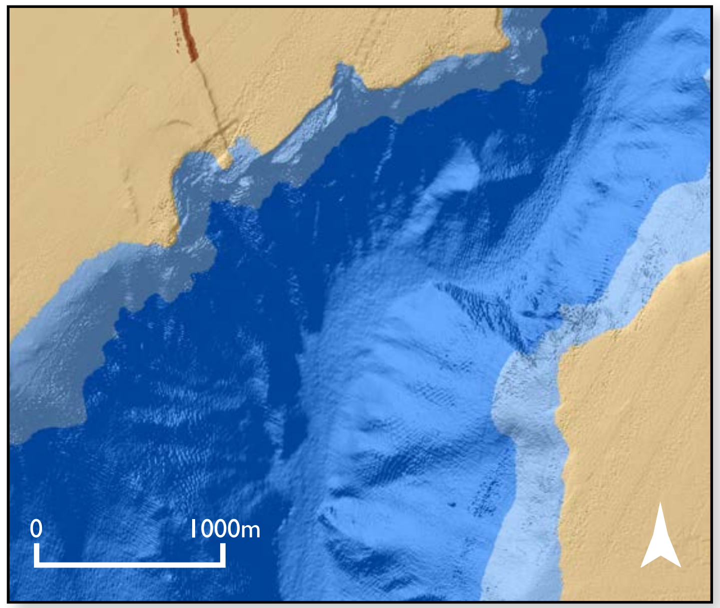
Depth	Sediment	Rock
0-30 m	50.4%	49.6%
30-100 m	99.6%	0.4%



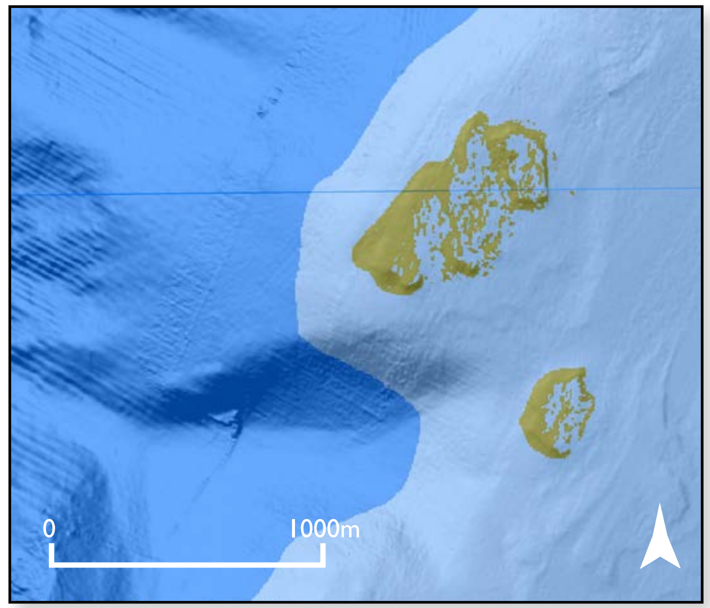
Monterey Bay

Soquel Canyon SMCA Portuguese Ledge SMCA

Monterey Bay is dominated by three major physical elements: smooth continental shelf, canyon walls, and canyon floor. The shelf has long, wide corridors of alternating sand and mud that parallel the coastline. Monterey Canyon is the dominant bathymetric feature on the U.S. west coast. It is as large as the Grand Canyon, so it is difficult to succinctly summarize. (A) In this box, the shelf is 90 m (300 ft) deep, and the canyon floor is 500 m (1640 ft) deep. The canyon walls have a 40% grade, or about 20° of slope. The canyon walls and floor are draped with a thick blanket of fine-grained sediment that is very infrequently disturbed. (B) Here, the topographic break between the continental shelf and slope occurs at a depth of 130 m (425 ft), which is the approximate shoreline position 18 thousand years ago. The canyon bottom within the Portuguese Ledge SMCA is 1230 m (4030 ft) deep. The substrate on the ledge is largely featureless fine-grained sediments and very low relief mudstone.



Ⓐ Submarine canyons bring deep water habitats close to shore in Monterey Bay and elsewhere along the central coast. Here the steep walls and mud floor of Soquel Canyon are draped with a thick blanket of fine-grained sediment.



Ⓑ Here the outer continental shelf is dominated by fine-grained sediments and an abrupt shelf break along the margins of the Monterey Submarine Canyon.

Portuguese Ledge SMCA (27.5 Km²)

CSMP Data coverage - 27.5 Km²

Depth	Sediment	Rock
30-100 m	89.2%	10.8%
100-200 m	93.7%	6.3%
> 200 m	100%	0%

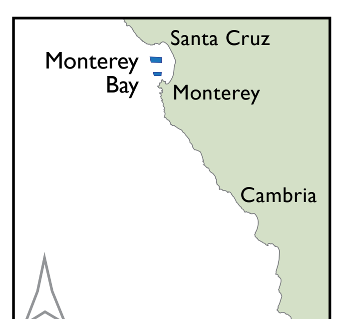
Soquel Canyon SMCA (59.4 Km²)

CSMP Data coverage - 59.2 Km²

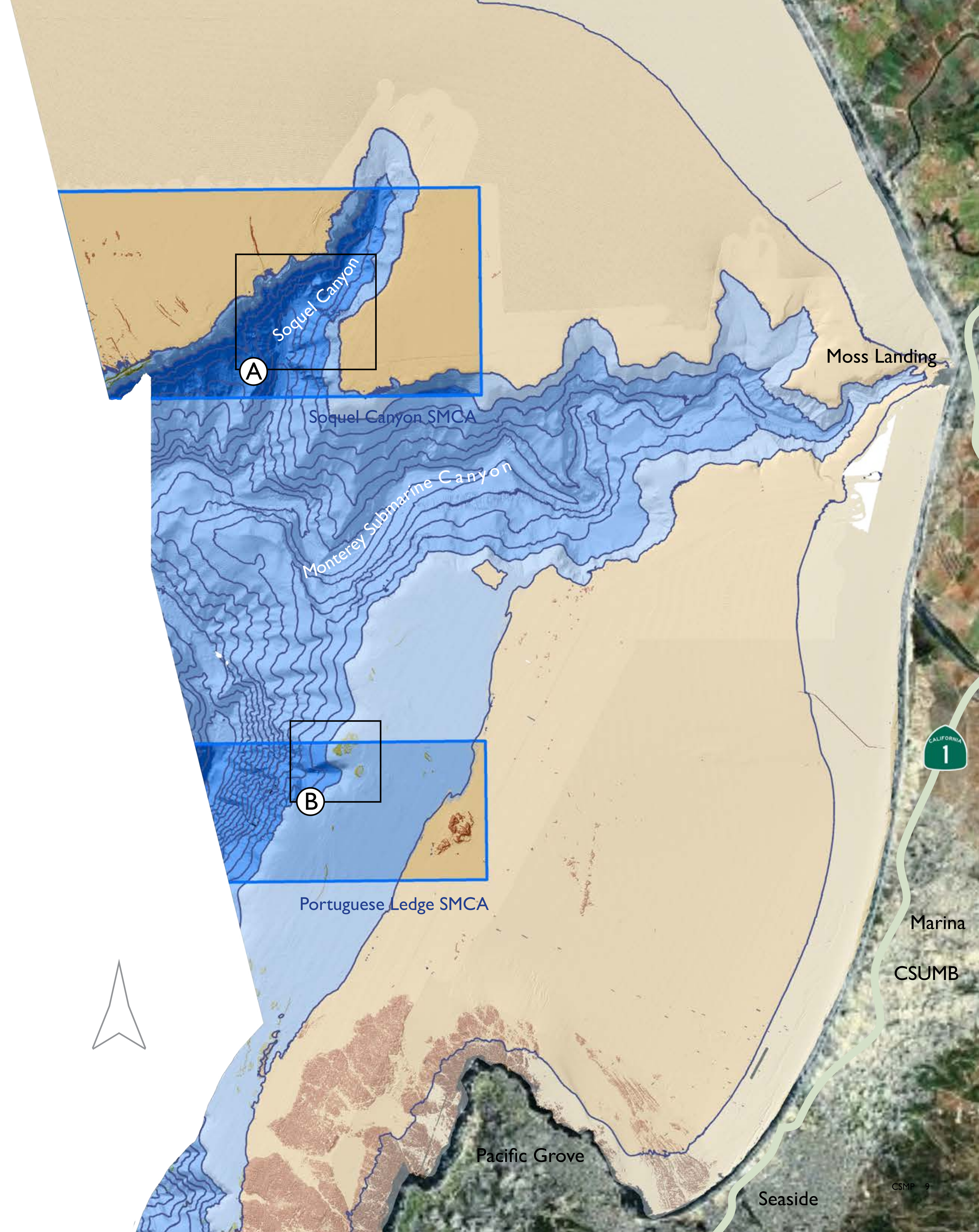
Depth	Sediment	Rock
30-100 m	98.5%	1.5%
100-200 m	96%	4%
> 200 m	100%	0%

☐ SMCA

Depth	Sediment	Rock
0-30 m		
30-100 m		
100-200 m		
> 200 m		



0 5000 m 10,000 m

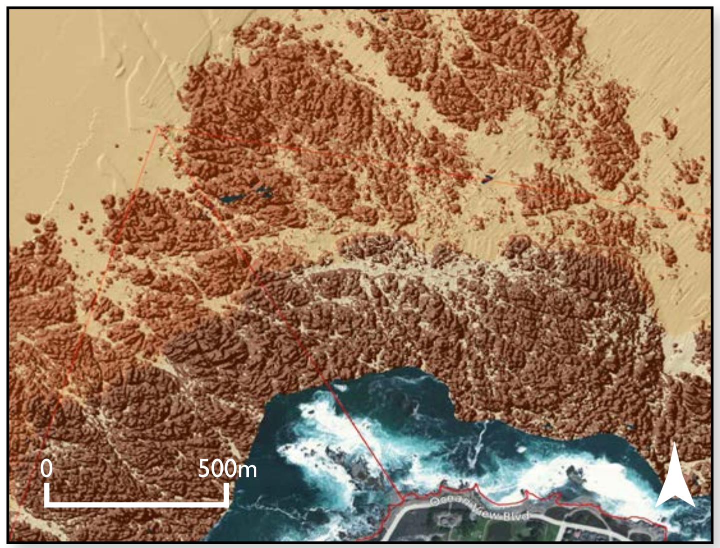


Monterey Peninsula

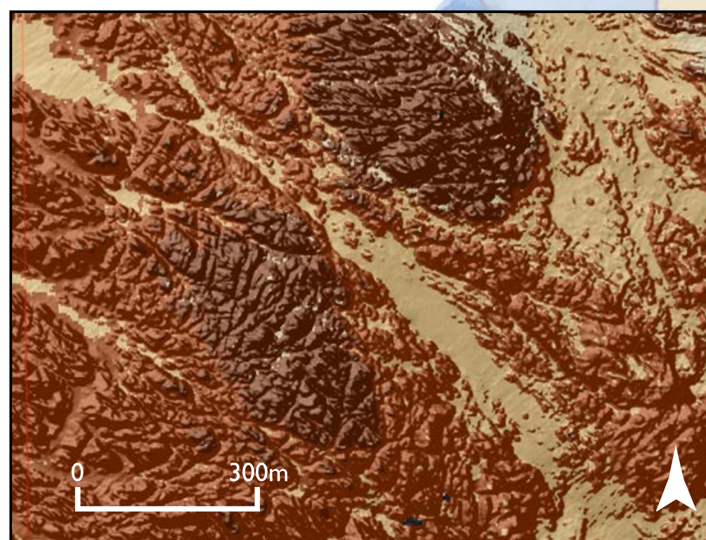
Lovers Point SMR, Asilomar SMR, Carmel Pinnacles SMR

Edward F. Ricketts SMCA, Pacific Grove Marine Gardens SMCA, Carmel Bay SMCA

Granitic rocks fortify the rocky headlands and nearshore continental shelf of the Monterey Peninsula. The hard bedrock is etched by a spider's web of narrow, sand filled fractures, faults and valleys. (A) The cracks are typically 1 m (3 ft) in relief, and a few tall rock spires stand 10 m (30 ft) above the general seafloor near Pacific Grove. (B) Spires and rock mounds in the Carmel Pinnacles reach 30 m (100 ft) tall. The pervasive cracks are typical of granite-like rocks that physically expand as they are exhumed from deep underground. The wider gaps between granite outcrops may represent old stream channels, now submerged and filled with sand.



(A) Detail of the sand-filled fractures characteristic of the granitic habitat surrounding the Monterey Peninsula.



(B) The tall granitic spires and mounds comprising the Carmel Pinnacles MPA.

Lovers Point SMR (0.8Km²)

CSMP Data coverage - 0.5 Km²

Depth	Sediment	Rock
0-30 m	26.9%	73.1%

Asilomar SMR (3.9 Km²)

CSMP Data coverage - 2.3 Km²

Depth	Sediment	Rock
0-30 m	41.3%	58.7%
30-100 m	28%	72%

Carmel Pinnacles SMR (1.4Km²)

CSMP Data coverage - 1.4 Km²

Depth	Sediment	Rock
0-30 m	13.2%	86.8%
30-100 m	27.3%	72.7%
100-200 m	100%	0%

Edward F. Ricketts SMCA (0.6 Km²)

CSMP Data coverage - 0.5 Km²

Depth	Sediment	Rock
0-30 m	82.1%	17.9%

Pacific Grove Marine Gardens SMCA (2.4 Km²)

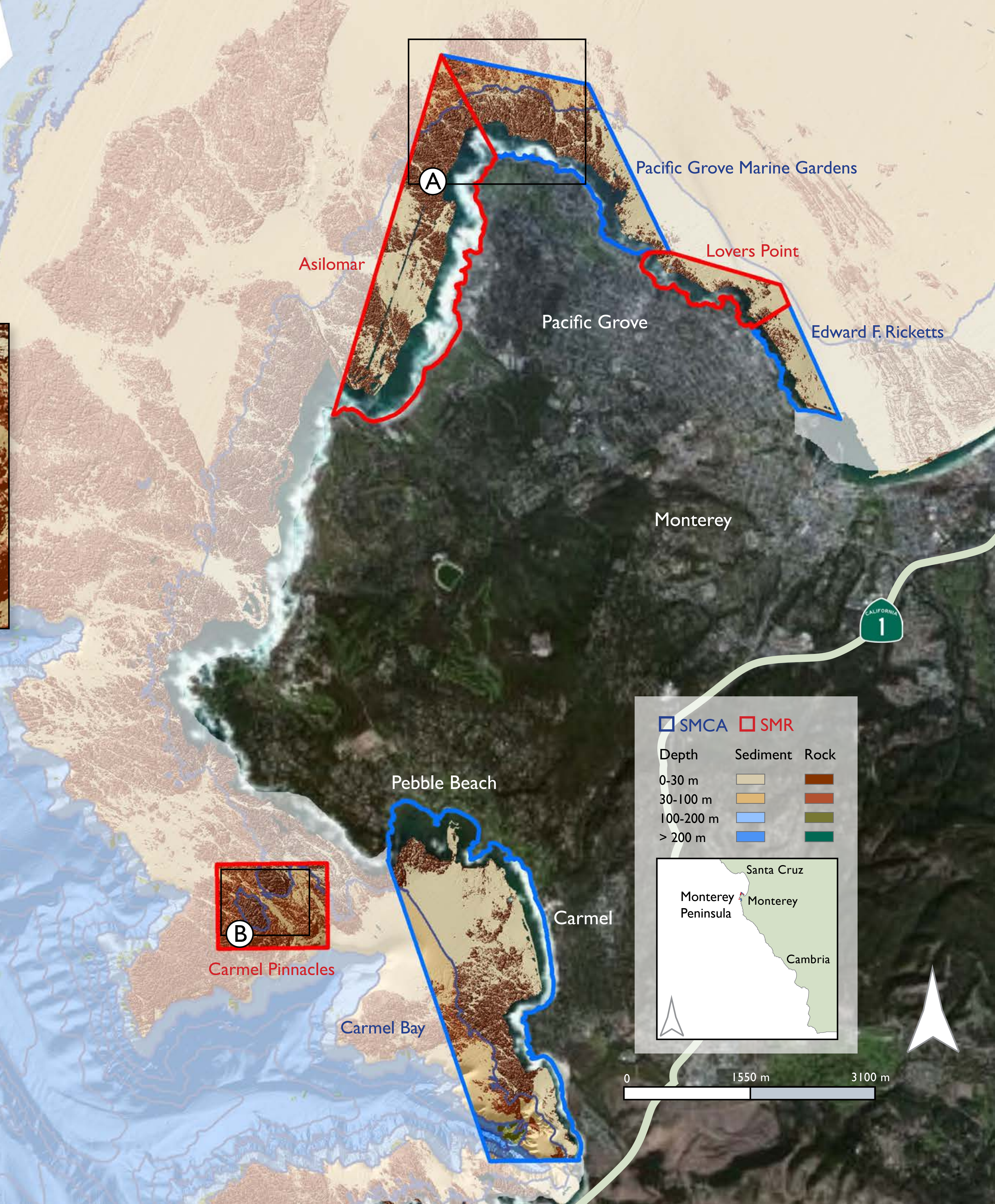
CSMP Data coverage - 1.8 Km²

Depth	Sediment	Rock
0-30 m	42.2%	57.8%
30-100 m	51.8%	48.2%

Carmel Bay SMCA (5.5 Km²)

CSMP Data coverage - 4.3 Km²

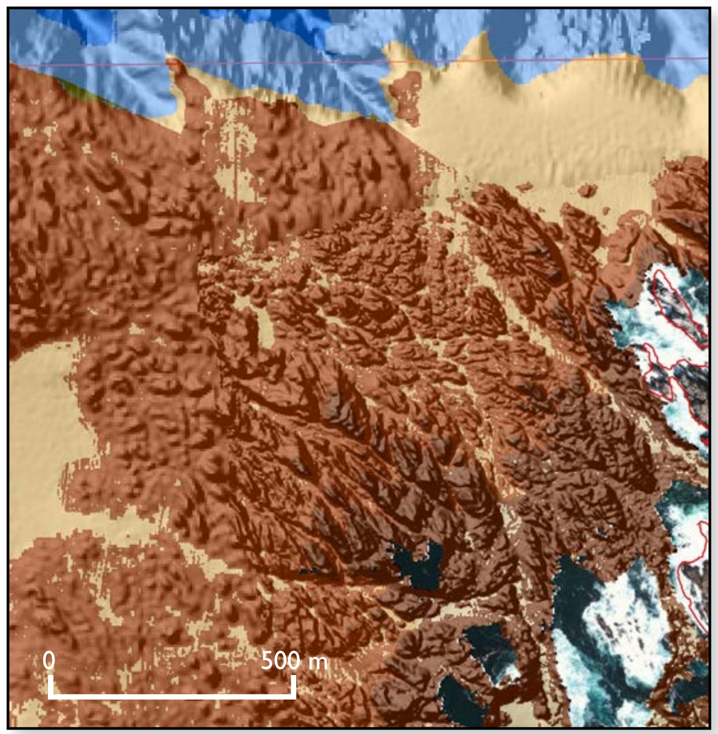
Depth	Sediment	Rock
0-30 m	62.7%	37.3%
30-100 m	74.1%	25.9%
100-200 m	69.5%	30.5%
> 200 m	95.9%	4.1%



Point Lobos

SMCA/SMR

The on shore geology of Point Lobos includes an ancient submarine canyon cut into granitic rock. The offshore geology is hard, pervasively fractured and faulted granitic rock. In this region, the rock fractures have been deeply eroded, leaving a complex, interconnected network of 10 m to 30 m (30 ft to 100 ft) tall spires and ridges. The deep cracks form a labyrinth of tall, vertical-walled granite valleys. A thin veneer of sand covers some of the valley floors.



(A) Detail of finely fractured and faulted granitic rock habitat characteristic of Point Lobos.

Point Lobos SMCA (21.9 Km²)

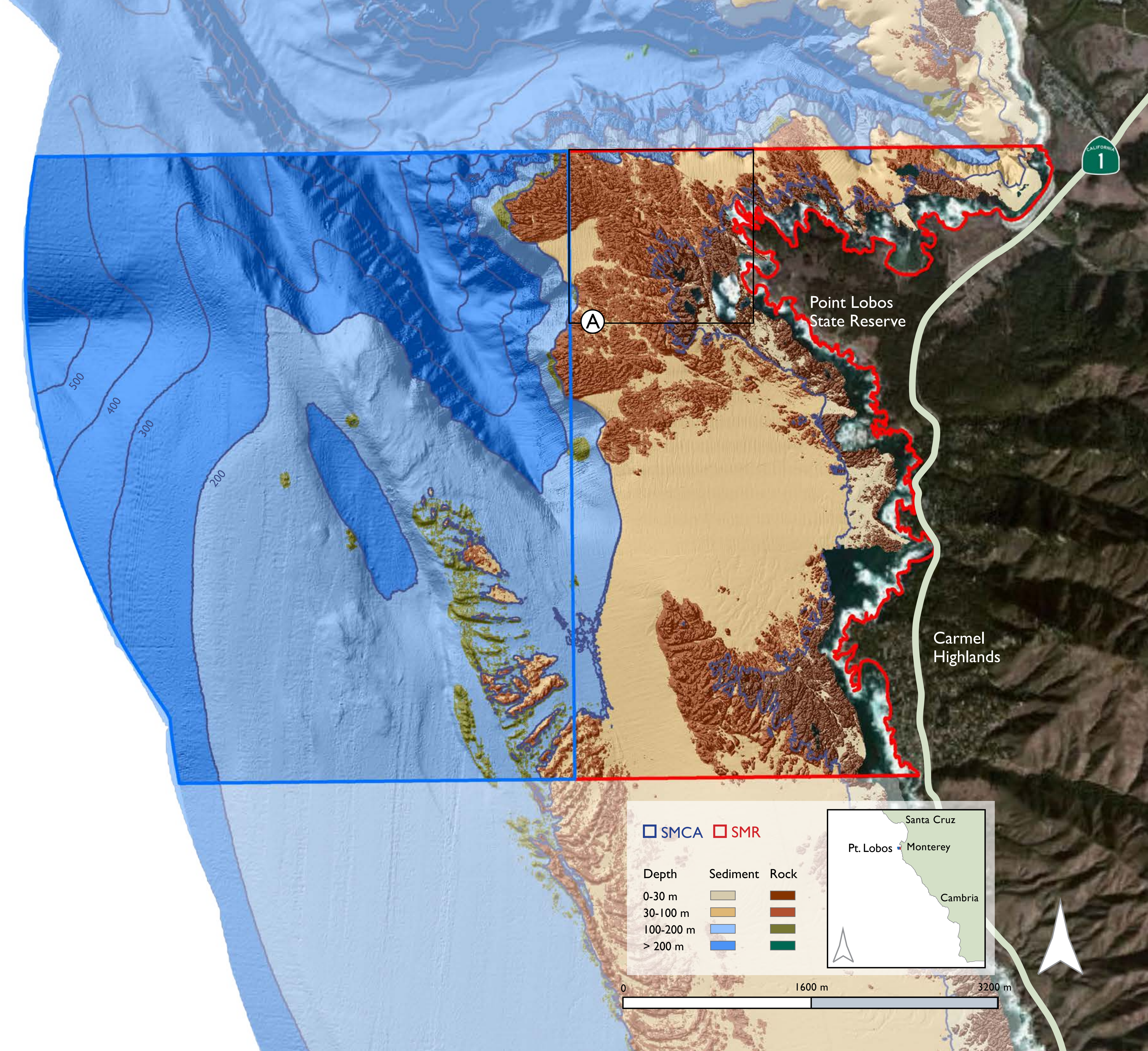
CSMP Data coverage - 21.9 Km²

Depth	Sediment	Rock
30-100 m	27.5%	72.5%
100-200 m	93.1%	6.9%
> 200 m	100%	0%

Point Lobos SMR (14 Km²)

CSMP Data coverage - 12 Km²

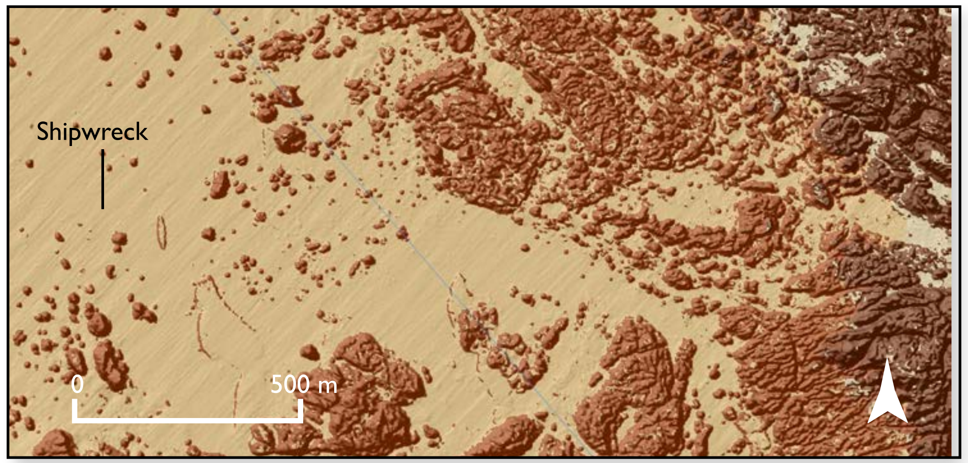
Depth	Sediment	Rock
0-30 m	24.8%	75.2%
30-100 m	59.7%	40.3%
100-200 m	95.5%	4.5%



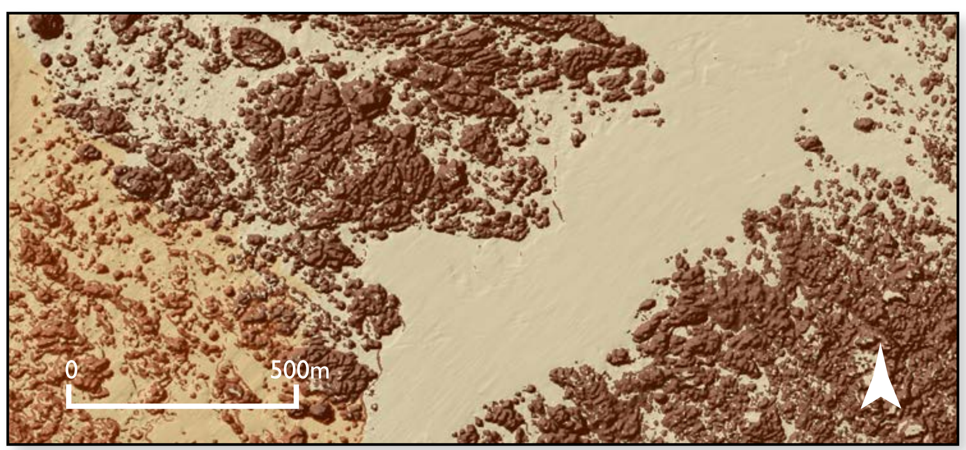
Point Sur

SMCA/SMR

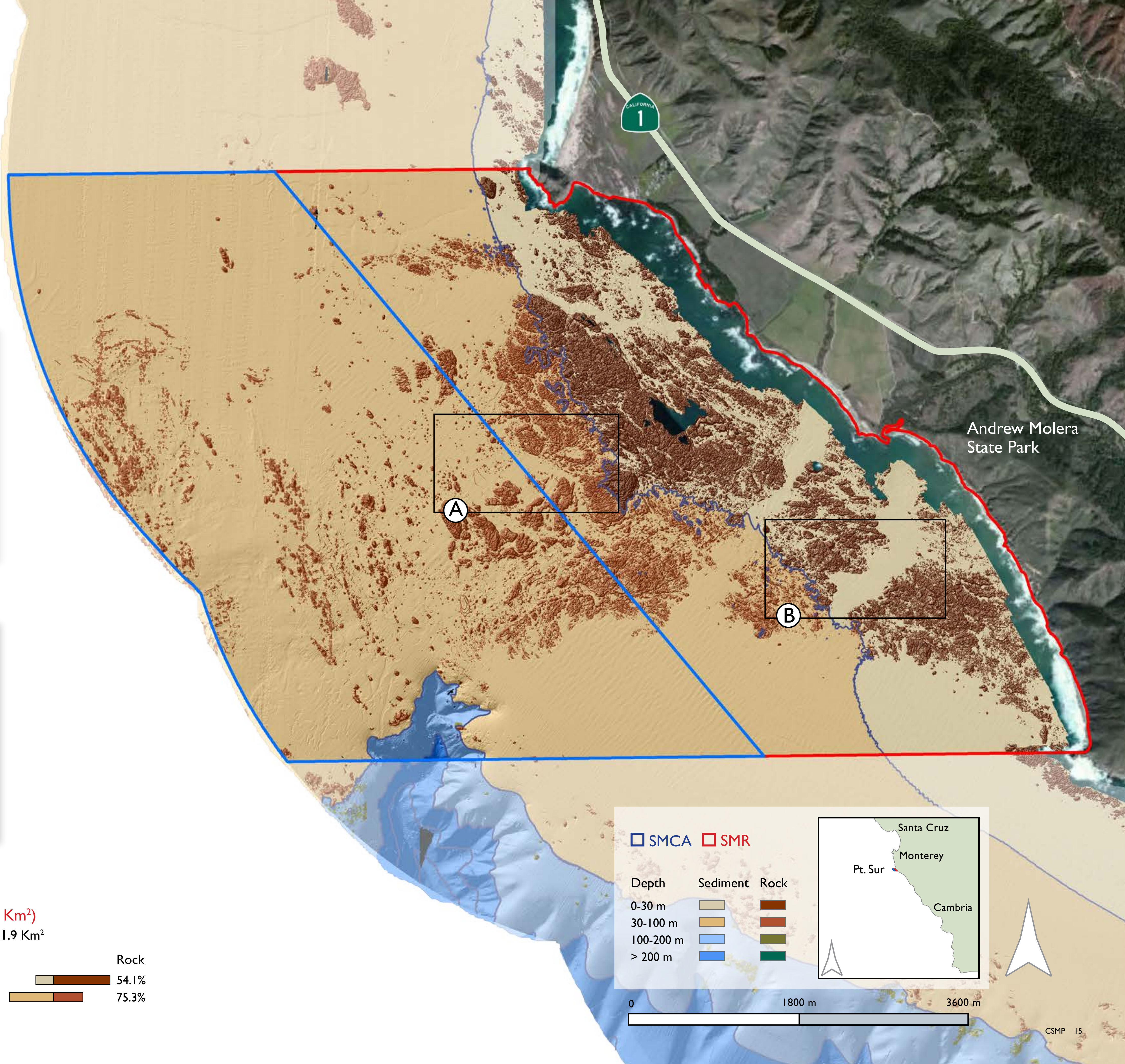
The Point Sur seafloor includes broad plains of modern sediment punctuated by topographically-complex outcrops of the Franciscan Formation. Franciscan rocks are a mélange of marine sedimentary rocks, metamorphic rocks (including serpentine and jade) and igneous rocks torn from an ancient oceanic plate as it dove beneath North America. The resulting outcrops represent very diverse habitats because rocks with different hardness and chemistry are randomly distributed across the map. The ridges and valleys have a typical relief of about 5 m (15 ft). (B) The broad swath of sediment extending seaward from the coast may represent a submerged river channel cut into the harder rock, now filled with sand.



(A) Close up view of the diverse rock types and geomorphologies found at Point Sur, along with one of California's many shipwrecks.



(B) This broad sediment channel may be a submerged river channel cut into the bedrock during a period of lower sea level.



Point Sur SMCA (27.5 Km^2)
CSMP Data coverage - 25.8 Km^2

Depth	Sediment	Rock
30-100 m	88.8%	11.2%
100-200 m	99.2%	0.8%
> 200 m	100%	0%

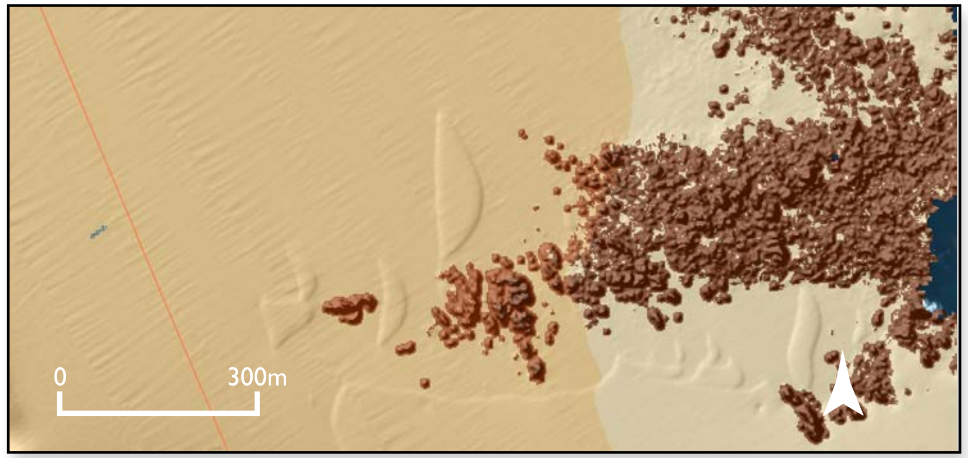
Point Sur SMR (25.2 Km^2)
CSMP Data coverage - 21.9 Km^2

Depth	Sediment	Rock
0-30 m	45.9%	54.1%
30-100 m	24.7%	75.3%

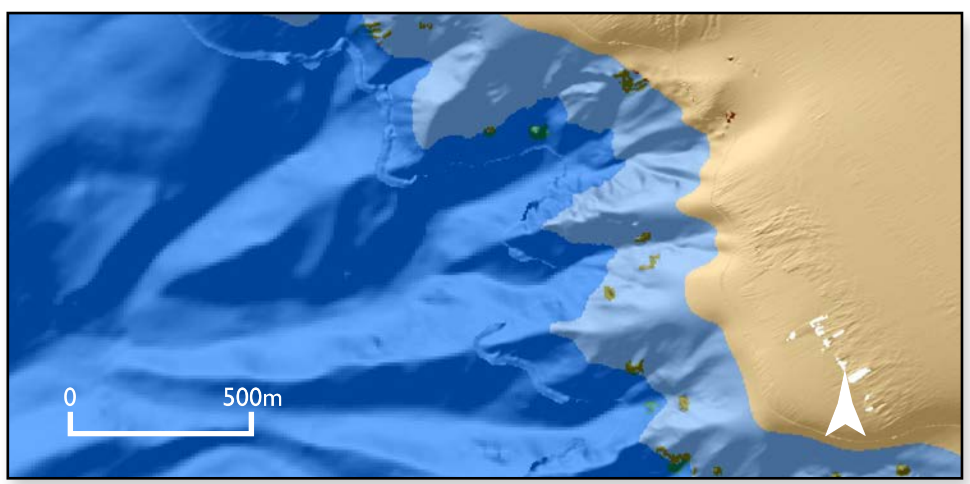
Big Creek

SMCA/SMR

The onshore geology of the Big Creek region is Franciscan Formation and pervasive landslides. The seafloor offshore from Big Creek comprises two main physical habitats: plains of modern sediment and (A) deeply fractured Franciscan Formation (or rock rubble from landslides of Franciscan Formation). (B) The very narrow continental shelf is cleaved by closely-spaced submarine canyon heads that are tributaries to larger canyons located farther offshore. Geomorphic evidence suggests that some canyon heads are locally growing shoreward. A northwest-oriented break in the sandy continental shelf may indicate the presence of an active fault.



Ⓐ Characteristic rock rubble and fractures associated with the Franciscan Formation.



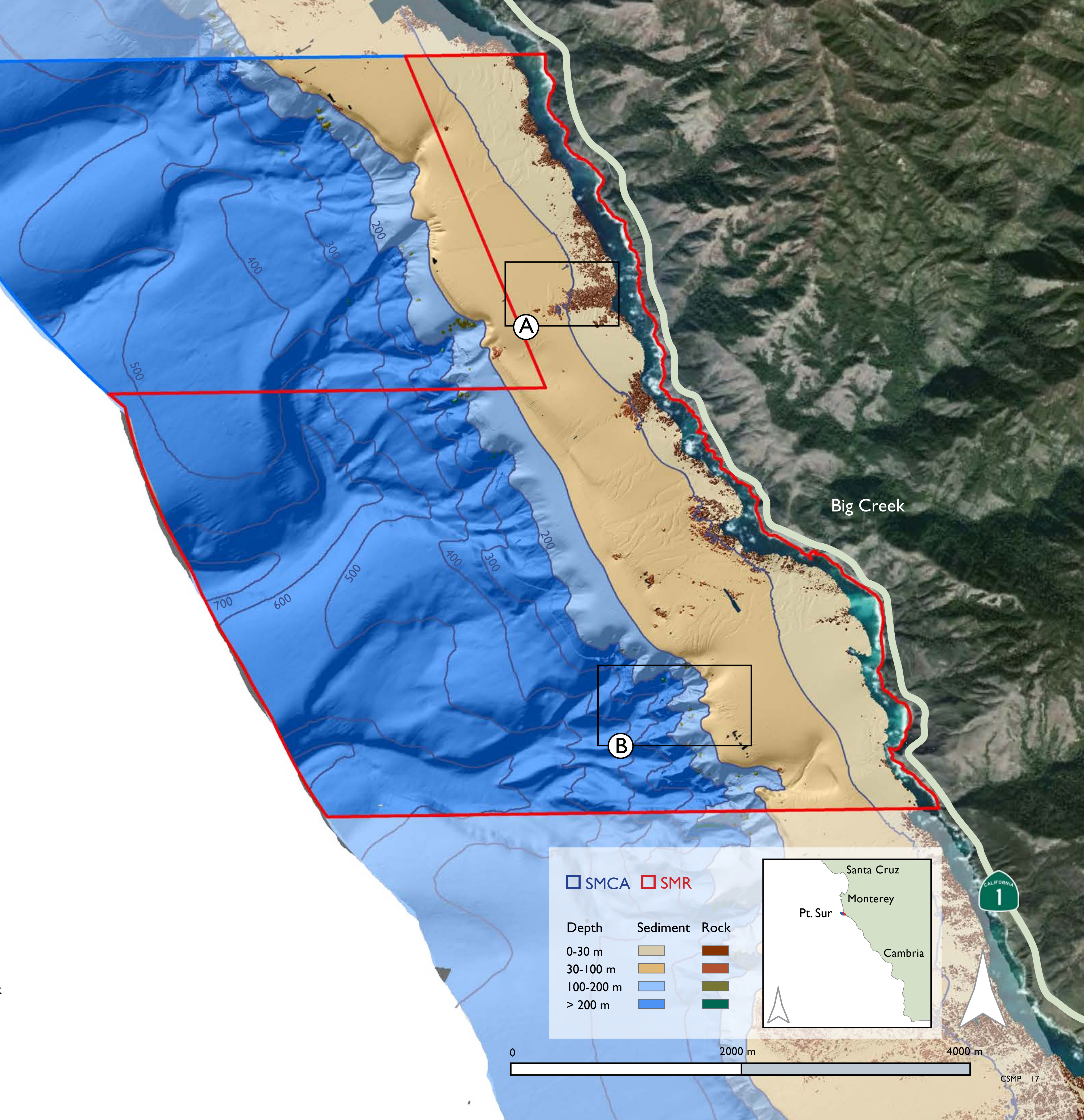
Ⓑ The closely-spaced tributary heads of the larger submarine canyons located farther offshore.

Big Creek SMCA (20.3 Km²)
CSMP Data coverage - 20.3 Km²

Depth	Sediment	Rock
30-100 m	99.2%	0.8%
100-200 m	97.8%	2.2%
> 200 m	99.9%	0.1%

Big Creek SMR (37.5 Km²)
CSMP Data coverage - 35.2 Km²

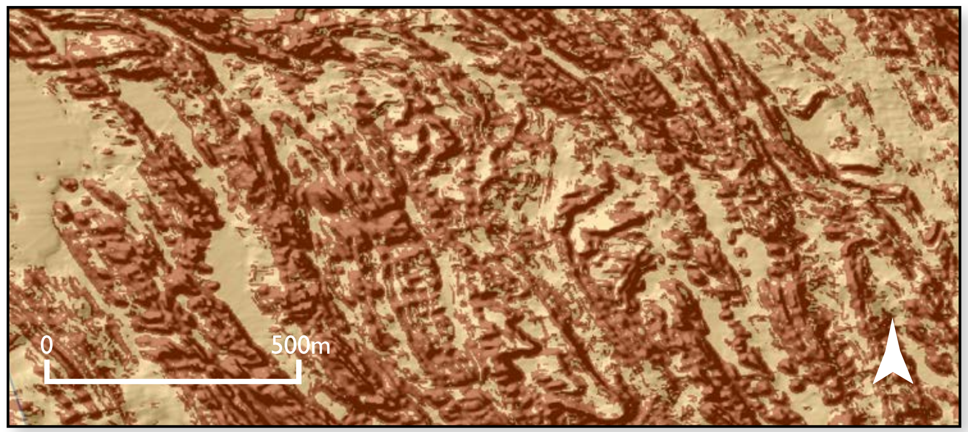
Depth	Sediment	Rock
0-30 m	86%	14%
30-100 m	98.2%	1.8%
100-200 m	99.1%	0.9%
> 200 m	99.9%	0.1%



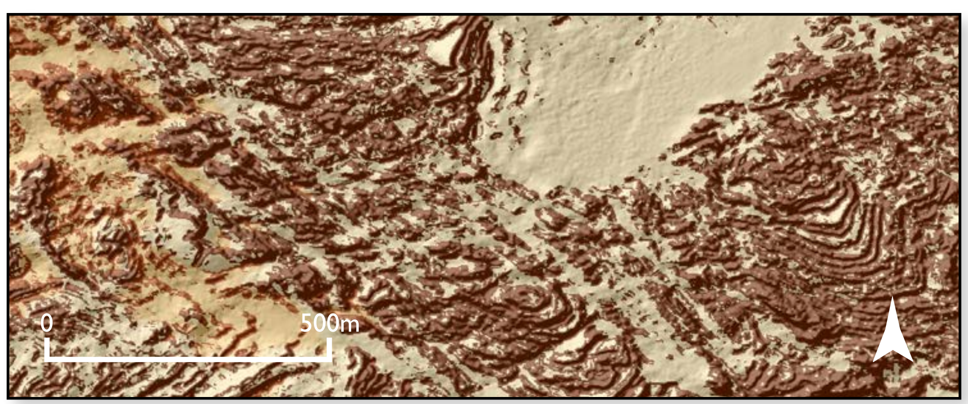
Piedras Blancas

SMCA/ SMR

The bedrock near Piedras Blancas represents some of the most geologically complex rocks in the world. Like the Point Sur rocks in the north, these Franciscan Formation rocks were scraped off of another tectonic plate and mixed together in a subduction zone trench that existed here 65 million years ago. The rocks are severely folded and pervasively fractured, providing a high level of habitat diversity. (A) The small-scale topography includes long, winding ridges and troughs with less than 1.5 m (4 ft) of vertical relief. (B) The ridges form "U" shapes showing that the rock layers are tightly folded; in some places they appear to form complete loops. Rock types probably include deformed sandstone, mudstone, chert, and a variety of hard metamorphic rocks. These rocks are mixed together instead of being neatly layered. The habitat diversity is accentuated by the presence of sandy corridors (submerged river channels) between bedrock outcrops.



(A) The small-scale topography of the Franciscan Formation includes long, winding ridges and troughs of low vertical relief.



(B) The "U" shaped-ridges indicate that the rock layers of the Franciscan Formation have been tightly folded.

Piedras Blancas SMCA (22.9 Km²)

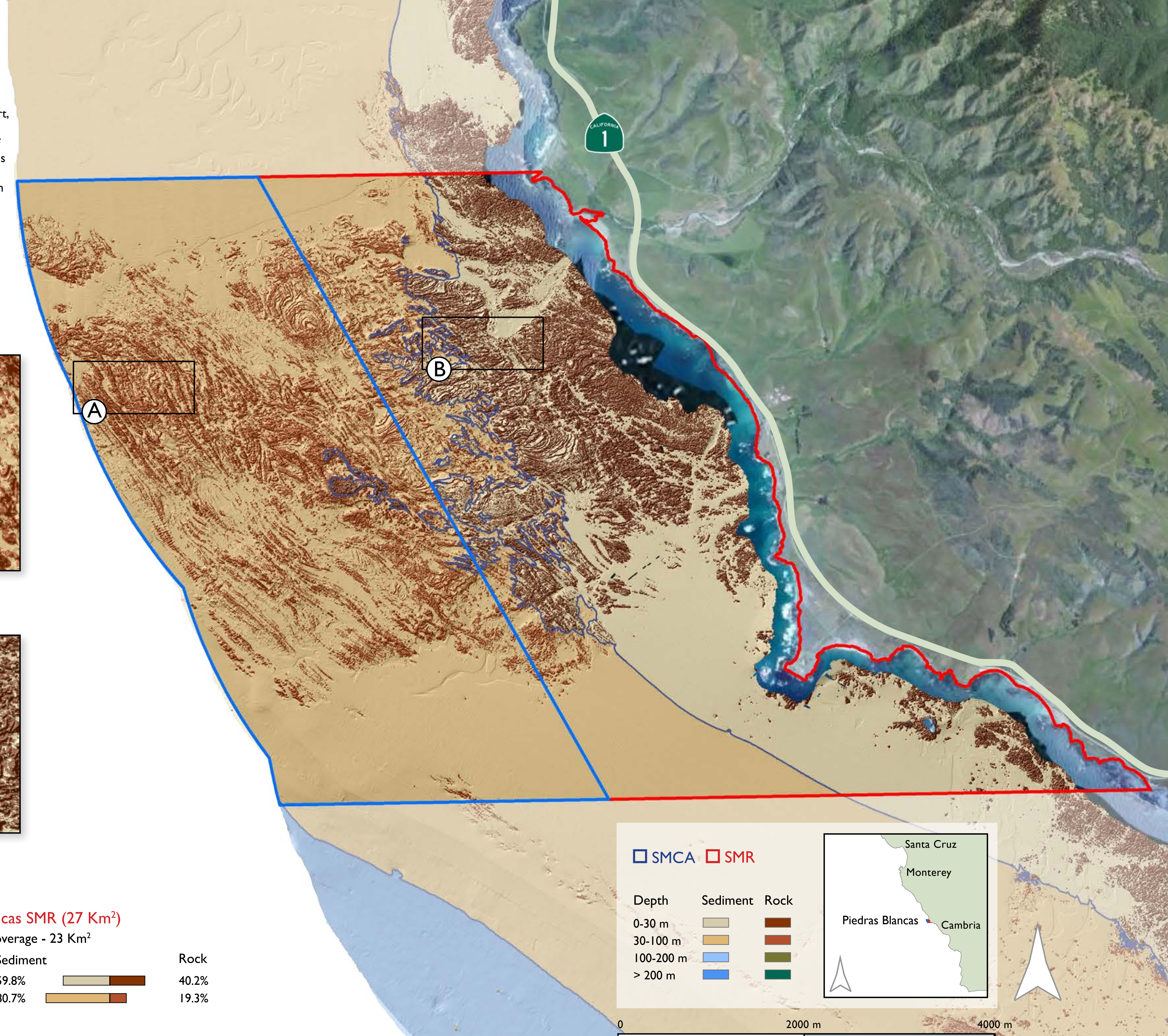
CSMP Data coverage - 22.5 Km²

Depth	Sediment	Rock
0-30 m	11.7%	88.3%
30-100 m	72.8%	27.2%
100-200 m	100%	0%

Piedras Blancas SMR (27 Km²)

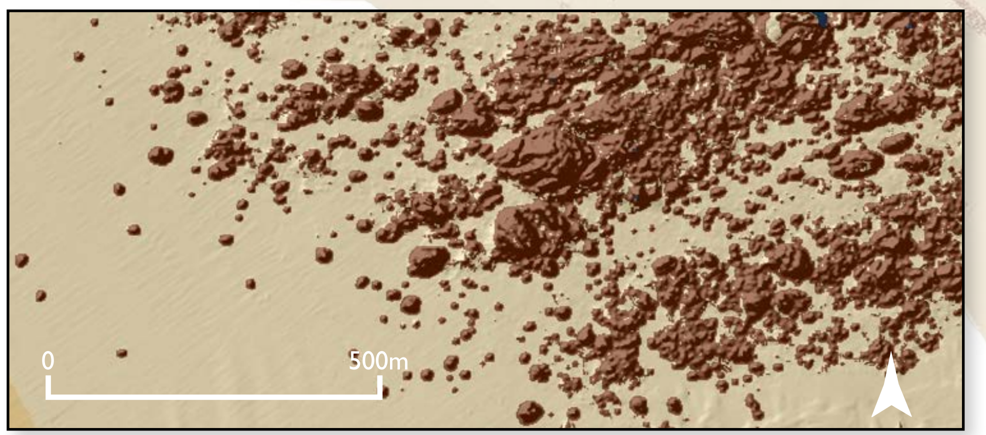
CSMP Data coverage - 23 Km²

Depth	Sediment	Rock
0-30 m	59.8%	40.2%
30-100 m	80.7%	19.3%

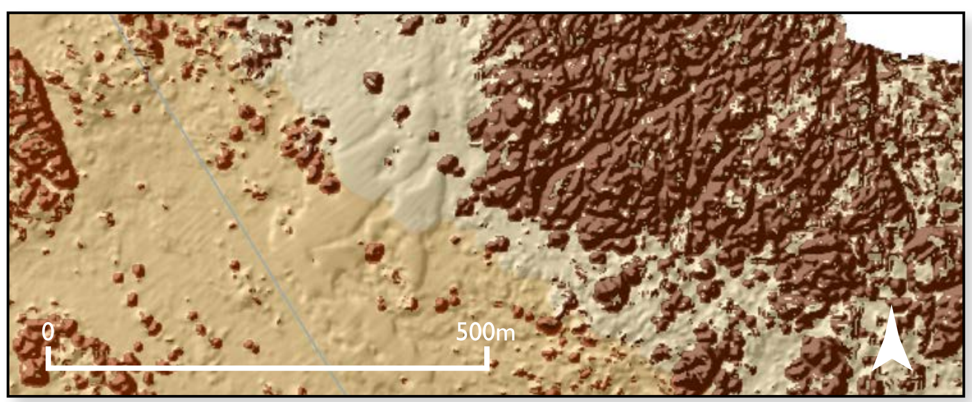


Cambria SMCA White Rock SMCA

The Franciscan Formation is exposed in the shoreline and continental shelf of San Simeon, Cambria and White Rock. The sedimentary rocks exposed here are so highly sheared and mixed that the bedding planes are not well preserved. (A) Instead of long winding sandstone ridges, the bedrock appears generally hard and featureless at the scale of the map, or as small isolated outcrops protruding from broad expanses of fine sediment. The topographic relief formed by fractures and faults ranges from less than 1 m (3 ft) to 5 m (15 ft). Submarine sand dunes approximately 0.5 m (1.5 ft) tall are locally present on the extensive sediment plains in the area. (B) Bedrock fractures form an intricate network of narrow, 2 m (6 ft) tall valleys. Sediment deposits form 1 m (3 ft) tall plateaus.



(A) The nearshore rocky habitat appears as continuous hard substrate thinning to small isolated outcrops protruding from the broad expanses of fine sediment found offshore.



(B) Bedrock fractures form an intricate network of narrow valleys, and sediment deposits form raised sandy plateaus.

Cambria SMCA (16.1 Km²)

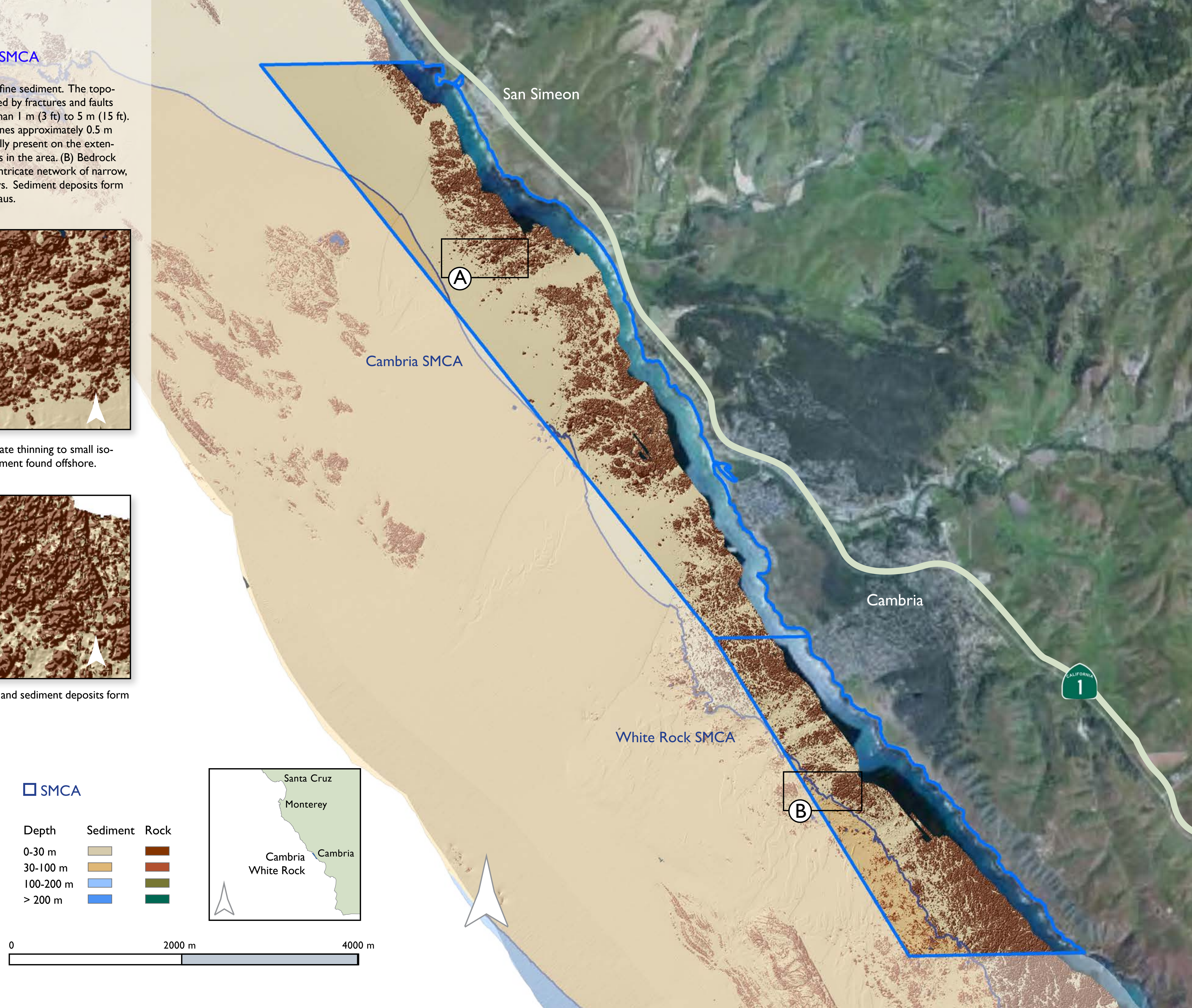
CSMP Data coverage - 13 Km²

Depth	Sediment	Rock
0-30 m	69.6%	30.4%
30-100 m	99.5%	0.5%

White Rock SMCA (7.6 Km²)

CSMP Data coverage - 5.4 Km²

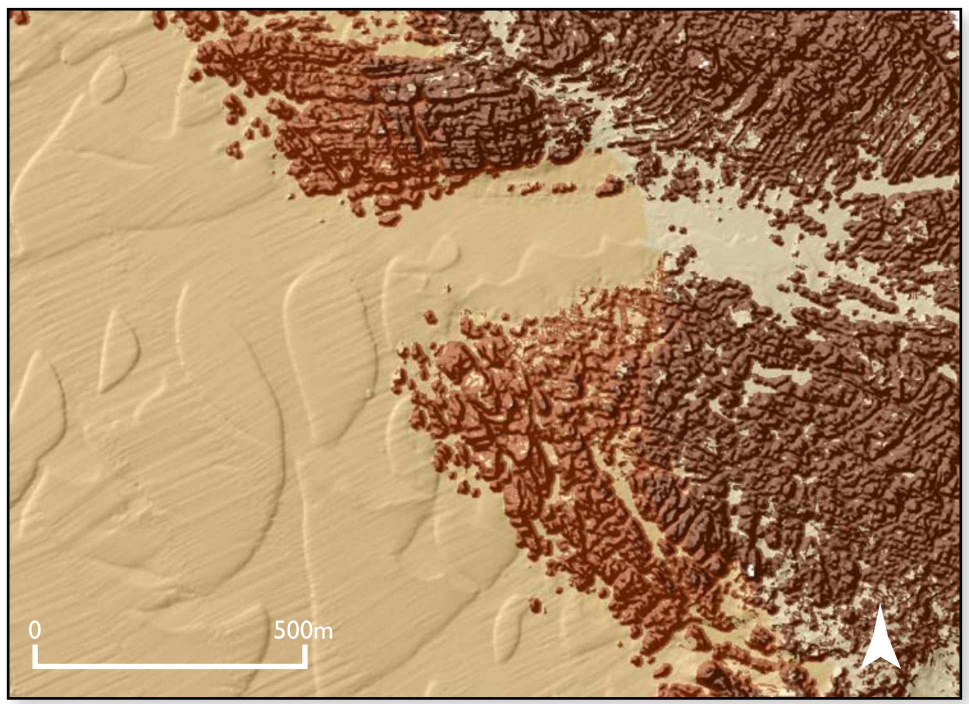
Depth	Sediment	Rock
0-30 m	42.5%	57.5%
30-100 m	80.3%	19.7%



Point Buchon

SMCA/ SMR

The seafloor near Point Buchon is dominated by sedimentary bedrock and sediment-covered plain of the continental shelf. The bedrock is thinly-bedded shale and chert of the Monterey Formation and Pismo Formation. The shale beds are fractured, faulted, tilted and moderately folded, providing an array of intricately connected ridges and crevasses. The sandy continental shelf displays a fascinating array of low geometric plateaus and rippled scour depressions (RSDs); an abundant and ecologically distinct sub-habitat of irregularly-shaped, shallow depressions containing coarser sediment and larger bedforms (sand ripples) than the surrounding fine sediment plateau.



(A) The thinly bedded Monterey and Pismo Formations combine with equally abundant RSD habitat to create one of the most complex submarine landscapes found on the central coast continental shelf.

Point Buchon SMCA (31.6Km²)

CSMP Data coverage - 29.8 Km²

Depth	Sediment	Rock
30-100 m	96.2%	3.8%
100-200 m	98.7%	1.3%

Point Buchon SMR (17.3 Km²)

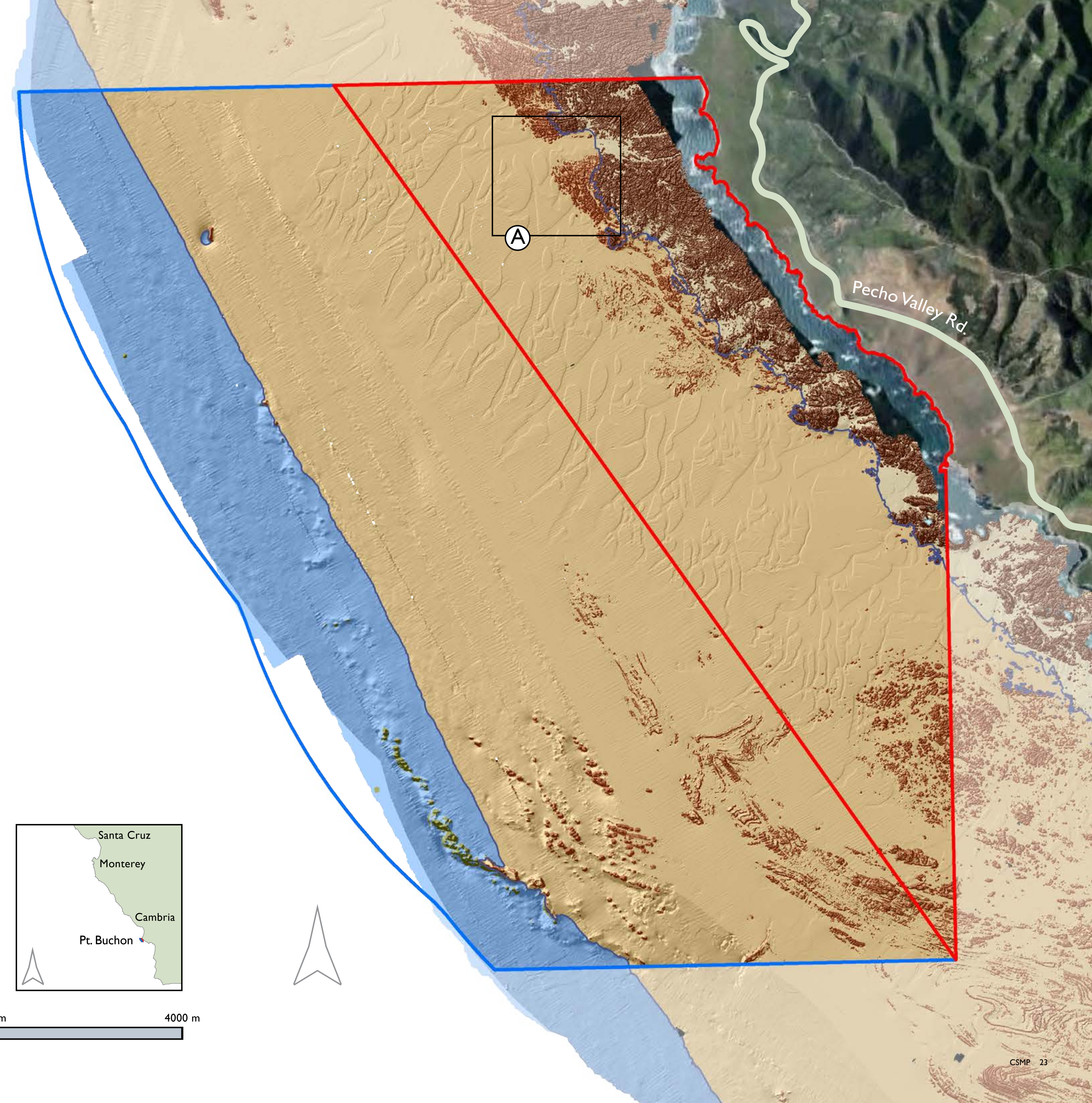
CSMP Data coverage - 15.8 Km²

Depth	Sediment	Rock
0-30 m	22.7%	77.3%
30-100 m	90.6%	9.4%

SMCA SMR

Depth	Sediment	Rock
0-30 m		
30-100 m		
100-200 m		
> 200 m		

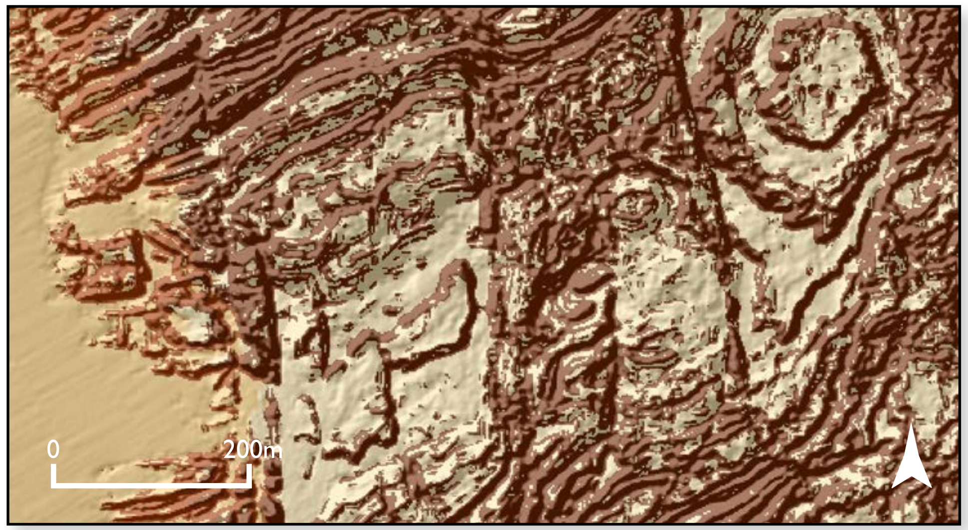
0 2000 m 4000 m



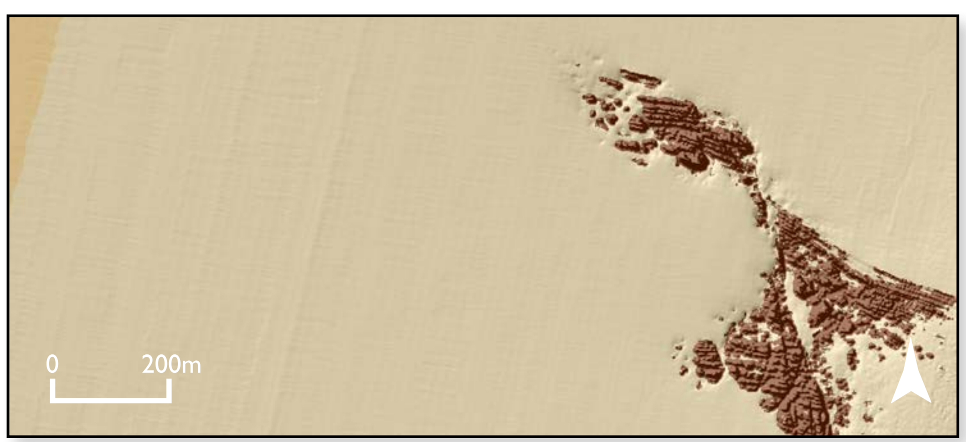
Vandenberg

SMR

The rocky coastline and shallow continental shelf quickly give way to a smooth sediment plain farther offshore. The shale beds of the Monterey Formation are tightly folded, giving rise to complex ridge patterns including straight, chevron "v"s, and broad curves. The intervening crevices are 1 m (3 ft) to 3 m (10 ft) deep. (A) The rocks are cut by a distinctive set of north-south oriented faults. (B) The sandy shelf dominates the region farther south, with only the tallest bedrock ridges left exposed above the sediment surface.



(A) The complex tightly folded rock ridges are cut by a distinctive set of north-south oriented faults. Some flat areas within the rock outcrop may be misclassified here as sediment. While rare, the surface roughness-based classification method sometimes has difficulty discerning flat, smooth rock from sediment.

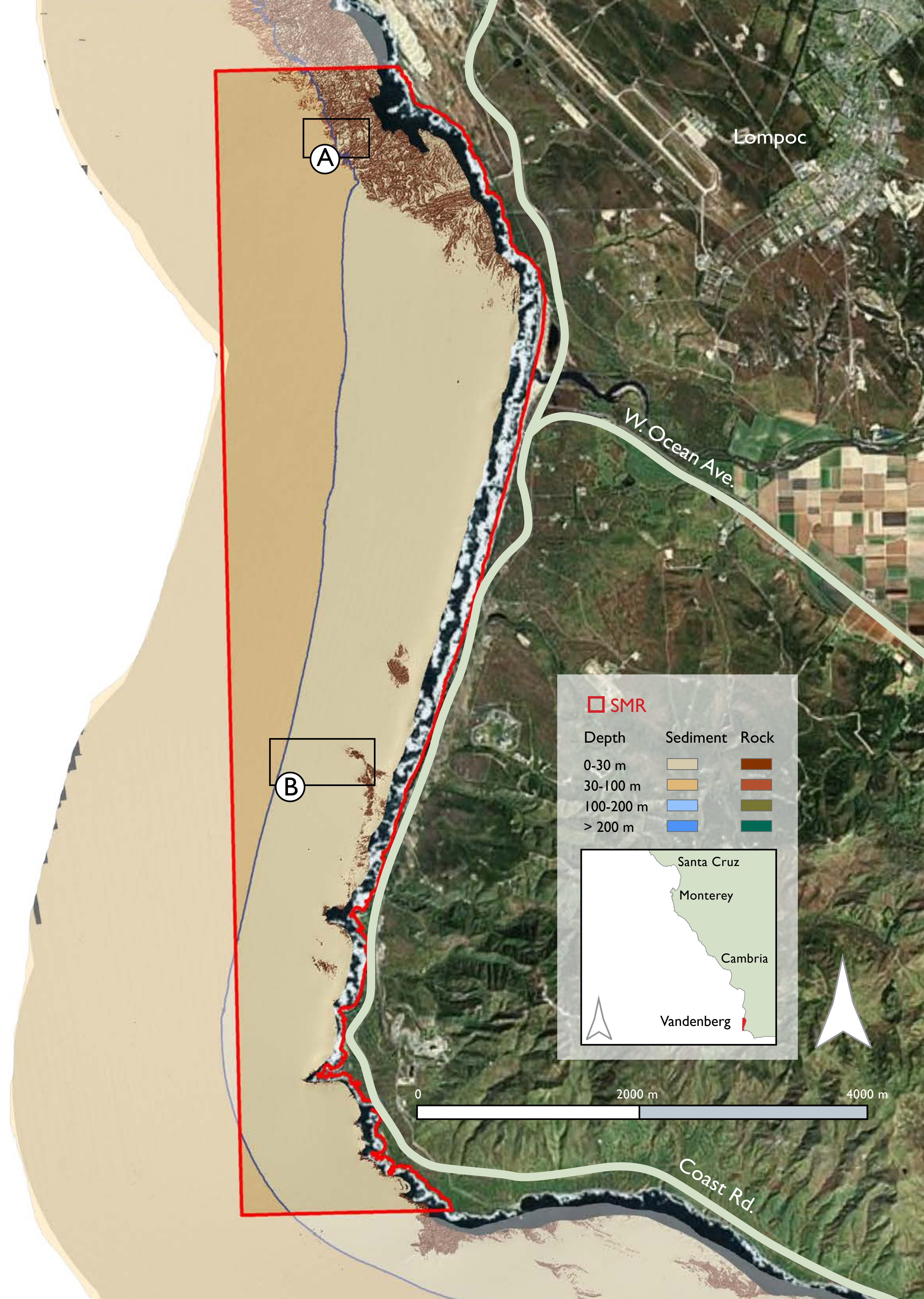


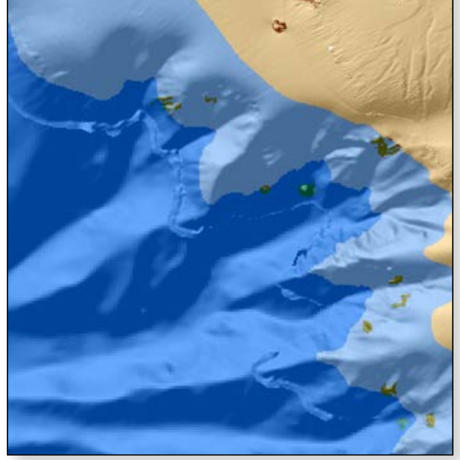
(B) For most of the Vandenberg MPA, only the tallest bedrock ridges are left exposed above the sandy surface of the shelf.

Vandenberg SMR (85.1 Km²)

CSMP Data coverage - 75.4 Km²

Depth	Sediment	Rock
0-30 m	91.8%	10.9%
30-100 m	99.2%	0.8%





Big Creek

California MPA Network Design

Regional Habitat Representation

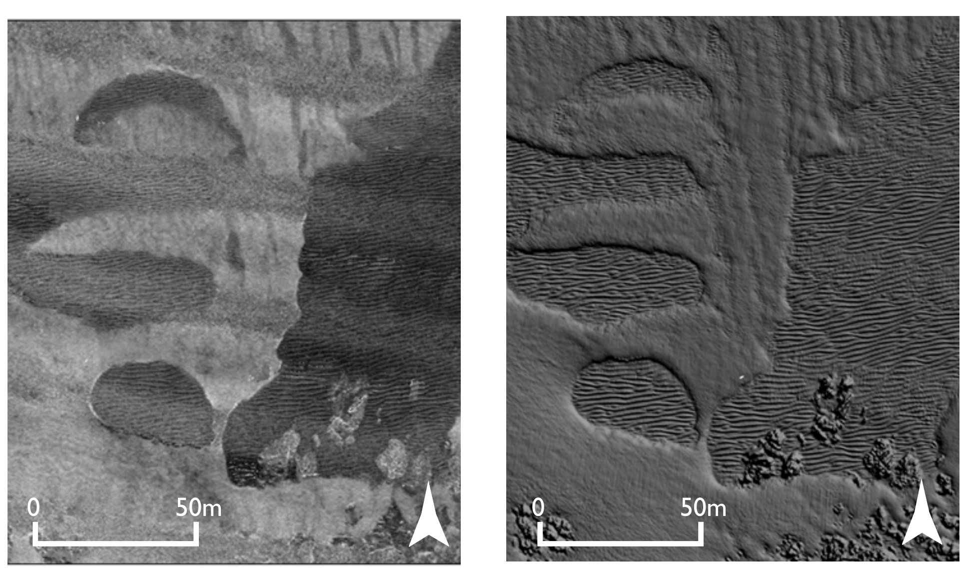
The Marine Life Protection Act (MLPA) of 1999 directed the State to redesign California's system of marine protected areas (MPAs) to function as a network in order to increase coherence and effectiveness in protecting the State's marine life, habitats, and ecosystems. To help achieve the MLPA goals, three types of MPA designation are used in the MLPA process: state marine reserves, state marine parks and state marine conservation areas. However, because MPAs can only be successful if they protect adequate amounts of those habitats utilized by target species, a major objective in the development of the California MPA Network has been the identification and protection of representative and unique marine life habitats within State waters. The MLPA Habitat Classification is based on two substrate types (sediment and rock) in four depth zones, which are often associated with changes in species composition: 0-30 meters, 30-100 meters, 100-200 meters, and greater than 200 meters. The MPA Network design criteria dictates each of the MLPA bioregions to have a set of MPA's that collectively capture regionally representative proportions of each of the eight habitat classes. The need to identify the distribution of the eight habitat types specified in the MLPA led to the California State Mapping Program (CSMP). Now, a third substrate type, rippled scour depressions (RSDs), has been found to be nearly as abundant as rocky habitat in State waters. RSDs are sediment features generally characterized as nearshore deposits of coarser-grain sediment with long-wavelength bedforms depressed 0.4-1.0 meters below the surrounding finer-grained sediment plateau. Because RSDs have recently been shown to influence the species composition and abundance of seafloor communities, they are treated in the regional habitat summaries presented here and on the next page as a third habitat class in addition to rock and non-RSD sediment.

The graphic to the right displays the distribution of MPAs within the Central Coast MLPA Region, with the state marine conservation areas (SMCAs) in blue and the state marine reserves (SMRs) in red. The corresponding circles for each MPA signify the relative size of each MPA in relation to the other MPAs in the network with the Vandenberg SMR protecting the largest area (85.1 km^2) and the Edward F. Ricketts SMCA protecting the smallest area (0.6 km^2). The bars to the right show the relative percentage of each habitat class within the depth zones for the individual MPAs (rock = brown, RSDs = blue, and non-RSD sediment = tan).

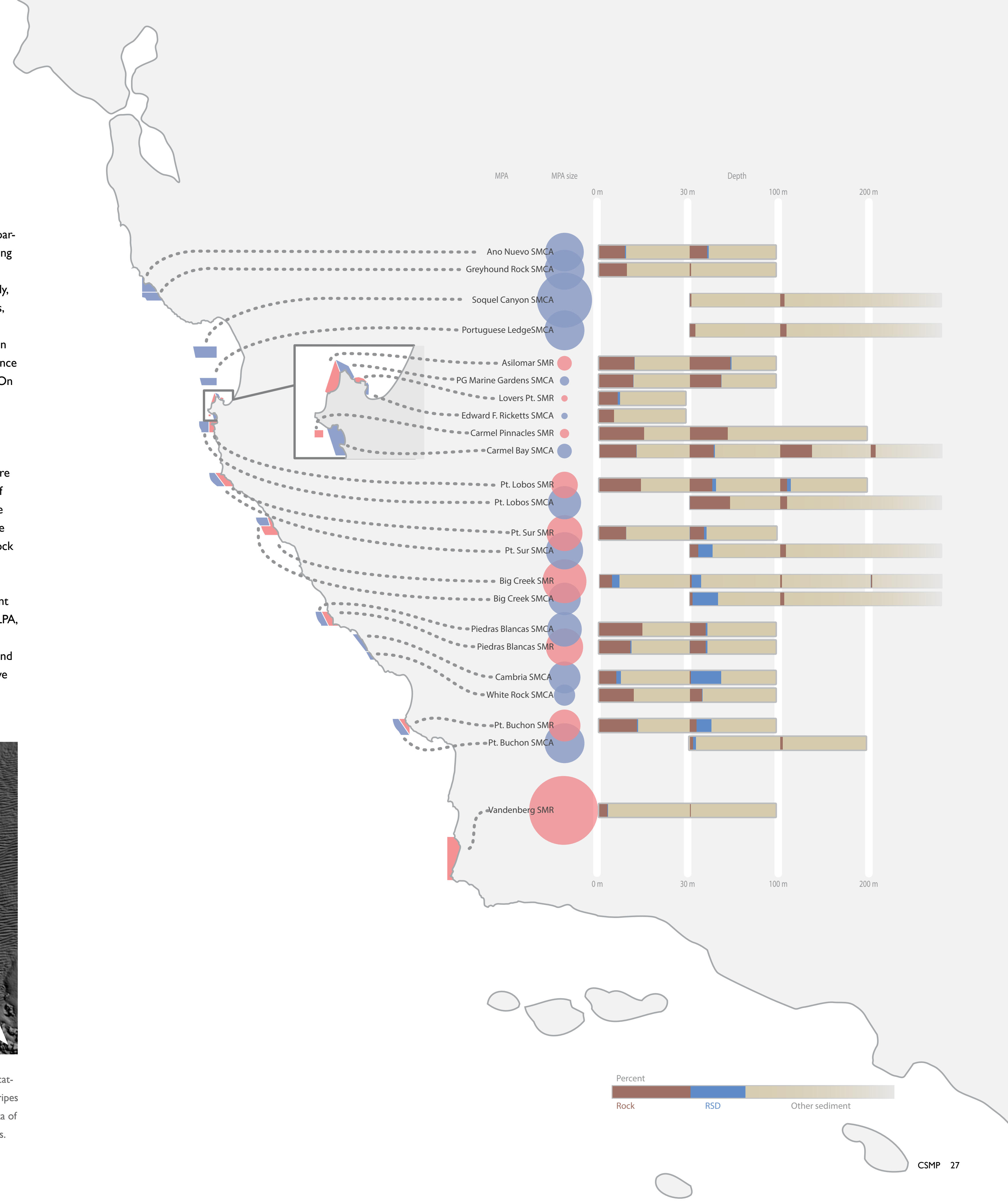
The table on the next page gives a quantitative comparison of the amount of each habitat class within the individual MPAs versus the regional totals, as well as the coverage of CSMP data versus the area of the MPAs. In the table, the habitat substrates are divided into Rock, Sediment (all sediment combined including RSD and non-RSD bottom types), and Rippled Scour Depressions (breaking out the percentages for RSD versus non-RSD sediments). While 91% of the MPAs are covered by the CSMP data, 23% of the 0-30 m depth zone remains unmapped. This persistent nearshore data gap is due to the inability of then-current, state-of-the-art methods and tools to collect bathymetric data for the CSMP, because of the presence of California's expansive kelp beds, breaking waves, and rocky shoals. Recent hydrographic survey innovations, such as the "KelpFly" pictured on page 28, have now made it possible to fill this critical data gap in the future.

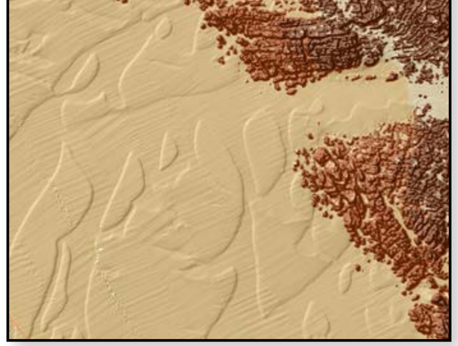
The table also contains "Predicted" and "Observed" columns within each substrate type comparing the percentages believed to be in an MPA during the designation of the network to the amount actually observed in the CSMP data. Unfortunately, during the designation of the Central Coast MPAs, comprehensive CSMP data were not yet available to the design teams, who were forced to rely upon existing data and the use of proxies such as presence of kelp signifying the location of rocky substrate. On a broad spatial scale, the habitat proxies provided a good basis for the representative designation of habitat. Conversely, when the predicted habitat is compared to the habitat derived from the CSMP data at a finer scale (the scale of an MPA), there are much larger discrepancies between the amount of substrate predicted vs. observed. For example, the predicted coverage of rock was much lower in the Piedras Blancas MPA than the actual amount of rock observed in the CSMP data.

Now, in keeping with the adaptive management of California's MPA Network mandated by the MLPA, the highly detailed CSMP data are being used to more precisely guide MPA biological monitoring and performance assessment, and to develop predictive models of marine life distribution and abundance.



Example of rippled scour depressions (RSDs) depicted in CSMP multibeam echo sounder data. Left) Sidescan sonar backscatter imagery showing the coarse-grained sediment of RSDs as areas of stronger (darker) acoustic return. The horizontal stripes across the backscatter image are characteristic artifacts of sidescan sonar and not seafloor features. Right) Bathymetry data of the same features shown in shaded relief illustrates distinct depression boundaries and larger-scale sand waves of the RSDs.





Point Buchon

Improved MPA Habitat Maps

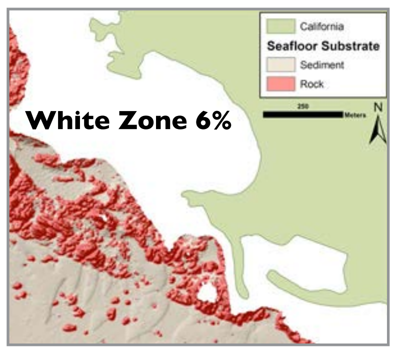
CSMP reveals previously unknown habitats

At the beginning of the MLPA MPA Network Design process, less than 30% of California's state waters had been mapped in sufficient detail to support the accurate delineation of the seabed habitat types stipulated in the MLPA: rocky reef and sedimentary substrates within each of four depth zones (0-30, 30-100, 100-200 and > 200 meters), as well as rocky pinnacles and submarine canyons. As a result, much of the central coast MPA planning had to proceed using the best available information to predict the distribution of these substrates. Because the information available was often sparse and coarse, or relied on proxies such as aerial kelp forest surveys to define the extent of rocky reef substrate, there was uncertainty as to how well the new MPA network design met the MLPA mandate to capture regionally representative proportions of these substrates.

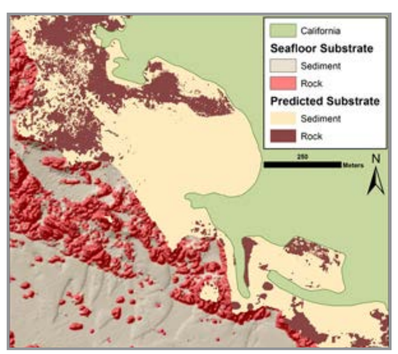
Now, with the release of the CSMP mapping results, these predicted habitat assumptions are being put to the test and revised. The revisions include a great many uncharted rocky reefs, more expansive submarine canyon heads, and the surprising extent of the previously unrecognized, but ecologically distinct, rippled scour depression (RSD) habitat. A notable example of these revisions falls within the Piedras Blancas MPAs, where CSMP data reveal 3 and 4 times more rock than the predictions used during the MLPA process within the 0-30m and 30-100m depth zones respectively.

Another complicating factor in generating accurate habitat maps, even with the new CSMP data, has been the presence of the "white zone" data gap that exists within the 0-10m depth range along most of the California coast, and which covers a significant proportion of some MPAs. This gap, which exists in all traditional hydrographic survey results, occurs wherever surf, submerged rocks, or floating kelp preclude the safe and effective operation of conventional seafloor mapping vessels. These same factors, as well as coastal fog and cloudy water, also reduced the effectiveness of the CSMP airborne bathymetric LiDAR effort to fill the white zone.

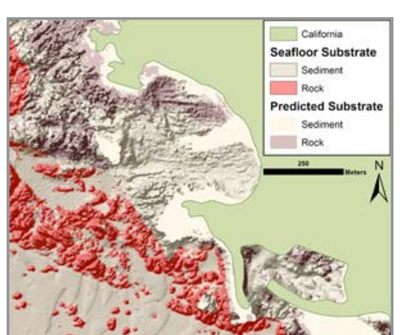
However, despite the difficulty in filling this data gap, many stake holder groups have identified the white zone as a high priority area for habitat mapping. For example, 40% of the kelp forest monitoring transect lines for the central coast biological base line study fall within the white zone data gap. This lack of overlap between habitat and biological data limits the ability to define the species/habitat relationships needed to create predictive maps of species distribution and density in the nearshore (see pg. 30). High regional demand for comprehensive nearshore data coverage prompted the West Coast Governors Agreement on Ocean Health to identify filling the white zone as a top priority, ultimately leading them to sponsor pilot efforts for the development of novel methods to fill the data gap. That support, augmented by Pacific Gas and Electric Company, enabled the CSUMB Seafloor Mapping Lab to develop the Research Vessel KelpFly pictured on the left. This unique hybrid jetski/airboat is mated to an armored rigid inflatable hull (RIB) and outfitted with ultra-wideswath bathymetric sonar enabling it to operate in the surf zone, over floating kelp, and rocky shoals of < 1 meter water depth. Although developed several years after the launch of the CSMP and thus not included in the original scope of work, the R/V KelpFly pilot program was used to fill the white zone gap in several demonstration areas crucial to resource management needs. As seen in the maps to the far right, these initial white zone mapping efforts included a number of central coast MPAs where KelpFly maps reveal dramatically more rocky habitat than predicted during the MLPA MPA design process. It is the intent of CSMP to continue to fill the white zone as funding becomes available.



CSMP Substrate Maps & Nearshore "White Zone" Data Gap

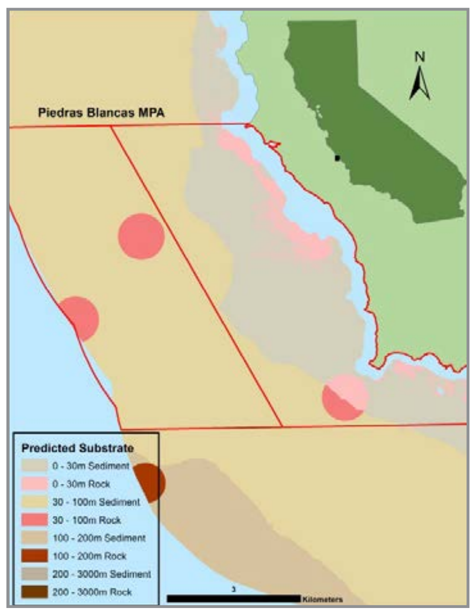


Substrate Predictions used in MLPA Process

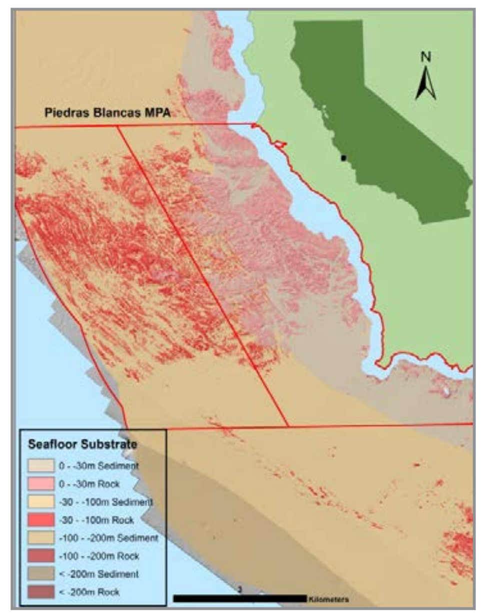


R/V KelpFly finds 100% more rock than predicted

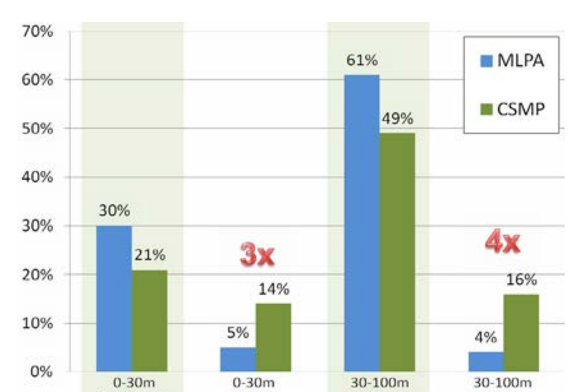
Dr. Rikk Kvitek built and guides the "KelpFly" through kelp forests and surf zone off Pt. Lobos filling in the critical nearshore CSMP data gap.



Pre-CSMP Piedras Blancas MPA Habitat Map used in MLPA Process. Circular predicted substrate patches were inferred from anecdotal evidence such as reported fish catch or other information.

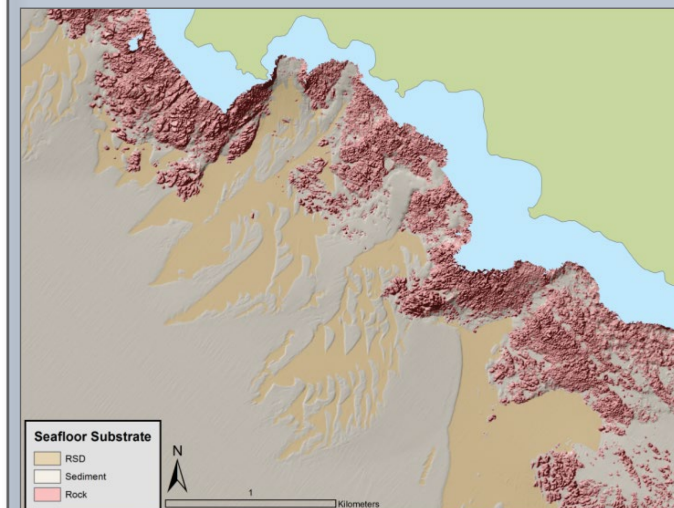


CSMP Piedras Blancas MPA Habitat Map



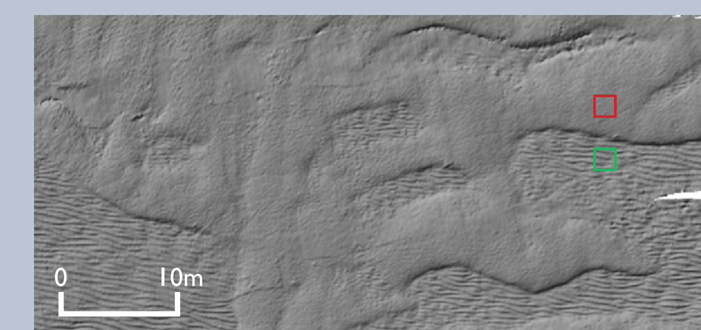
CSMP data now reveals 3-4 times more rocky habitat within the Piedras Blancas MPA than thought during the MLPA Network design process.

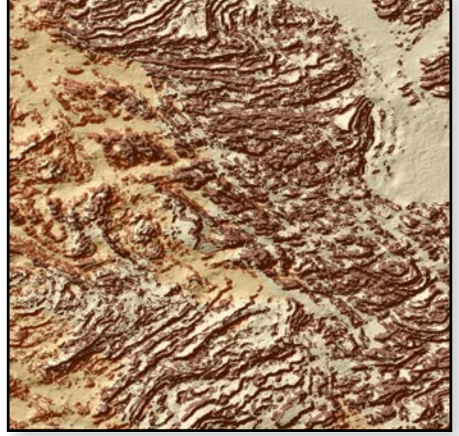
The Ecology of Rippled Scour Depressions (RSDs)



Images above are ROV video frames taken in 55 m water depth inside a RSD (left) and outside a RSD (right) at locations 17 m apart. Insets are photographs of corresponding sediment samples with coin shown for scale. Abundant Ophiuroid (brittle star) arms protrude from the finer sediment inside the RSD, but are completely absent outside the RSD where YoY rockfish hover between the prominent and comparatively barren bedforms of the much coarser RSD sediment. Paired laser scaling dots seen in both frames are 5 cm apart.

A major finding of the CSMP was the discovery that rippled scour depressions (RSDs) account for nearly as much of the central coast habitat (6.4%) as does rocky reef (8.9%). These results prompted the first ecological investigation of RSDs to see if these physically distinct features influence species distribution and abundance (Hallenbeck et al. 2012). That study found highly significant biological differences with much lower invertebrate densities inside the coarse grained RSD features than outside, but most surprisingly very high numbers of young of the year (YoY) rockfishes, especially canary rockfish, were found hovering near the bottom of nearly all 20 RSDs explored on the central coast. Few YoY were found over the surrounding sediments, suggesting that RSDs may be serving as a nursery habitat for some of the very species targeted in the MLPA for restoration through creation of the MPA Network.





Piedras Blancas

Ecoforecasting

Linking Habitat and Biological Data to Predict MPA Species Distribution and Abundance

Ecoforecasting refers to the integration of diverse data sets (seafloor habitats, physical and chemical oceanographic information, biological) to forecast or "now-cast" marine life population response to environmental variables. Because a primary goal of the MLPA and the MPA Network is to protect, sustain and restore marine life populations, knowing where the populations live and the ability to detect changes in their abundance is critical to assessing the success of the MPA Network. Now, with the release of the CSMP habitat and the Monitoring Enterprise biological observation data, landscape ecology models can be used to create highly detailed predictive maps of marine life abundance and distribution. Many fish, plants and invertebrate species living in, on or near the seabed tend to associate with particular combinations of seafloor depth, slope, rugosity (roughness or relief), topographic position (valley, peak, side wall, etc.), and sediment type, all of which can be derived as map layers from the basic CSMP data sets. This is why from the fishes' perspective not all rock is equal, because different combinations of these habitat variables favor certain species more than others. This diversity in the physical character of seafloor habitats is easily seen in the simple shaded relief images created from the CSMP digital elevation models (DEMs). In addition to these derived seafloor properties, species' habitat preferences can be further influenced by other factors including oceanographic variables, life stage and the presence of biological structure such as kelp.

Landscape ecology models can take the biological observation data from a few narrow survey transects, and superimpose them on the derived habitat variable maps to determine which combinations of habitat variables are present at the exact location of each observed species. This habitat preference profile for each species can then be applied to the relevant habitat layers to produce predictive maps of species distribution and estimates of their abundance for an entire MPA. This approach takes full advantage of the fine scale detail in the CSMP data and the position information within the biological data whenever it is available. Moreover, when groundtruthed with additional biological data this approach has been shown to yield far more accurate estimates than those derived from simple rock/sediment/depth habitat categories, which tend to overestimate population numbers as demonstrated in the table below. These species maps can help re-evaluate MPA network designs, assess changes in population status over time, and predict population response to a variety of environmental influences including climate change, ocean warming and human activities.

References:

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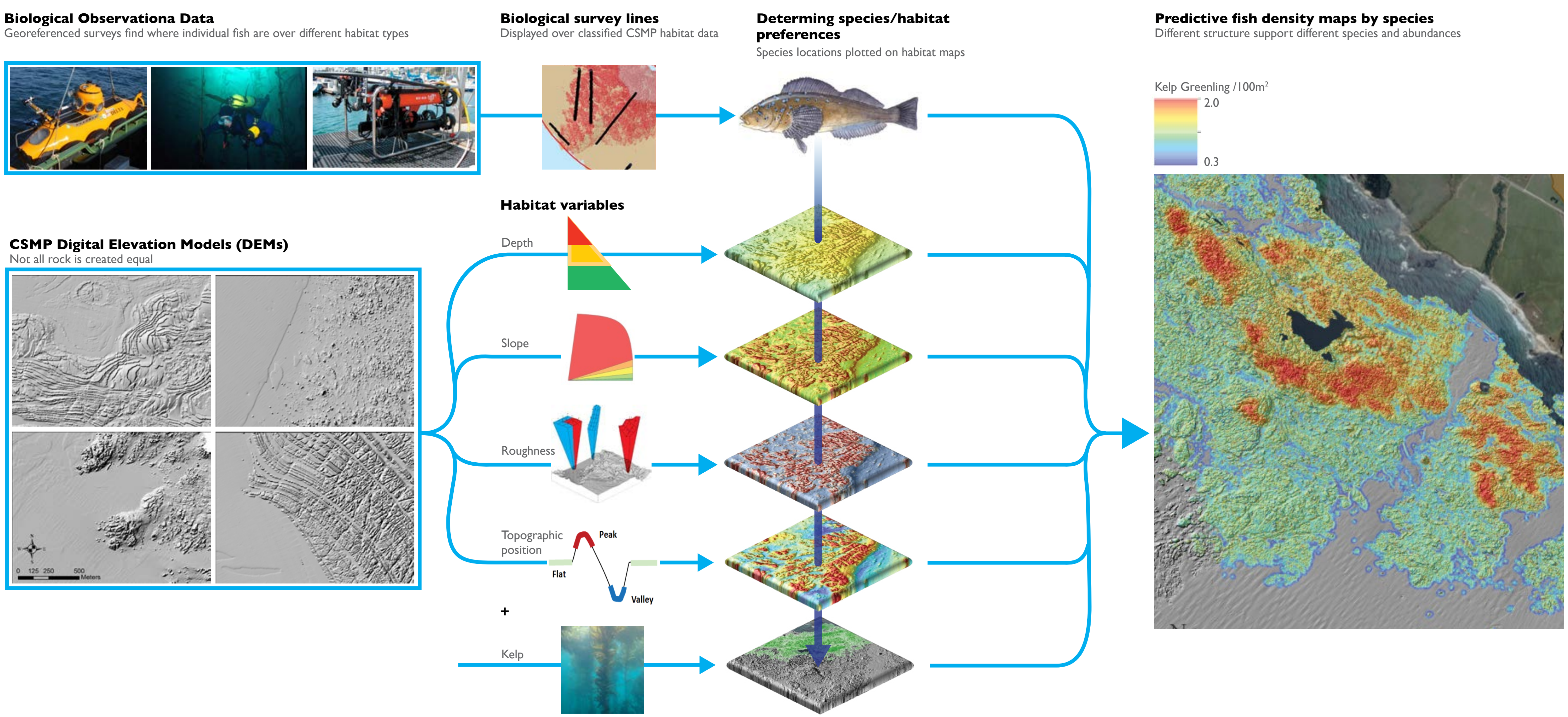
Iampietro, P. J., M. A. Young, R. G. Kvitek (2008) Multivariate Prediction of Rockfish Habitat Suitability in Cordell Bank National Marine Sanctuary and Del Monte Shalebeds, California, USA. Marine Geodesy, 31:359 - 371

Young, M.A., P.J. Iampietro, R.G. Kvitek, C.D. Garza. (2010). Multivariate bathymetry-derived generalization linear model accurately predicts rockfish distribution on Cordell Bank, California, USA. Mar. Ecol. Progr. Ser. Vol. 415: 247-261.

Young, M.A., R. G. Kvitek, P. J. Iampietro, C. Garza, R. T. Hanlon (2011). Seafloor mapping and landscape ecology analyses used to monitor variations in spawning site preference and benthic egg mop abundance for the California market squid (Doryteuthis opalescens). Journal of Experimental Marine Biology and Ecology. 407:226-233

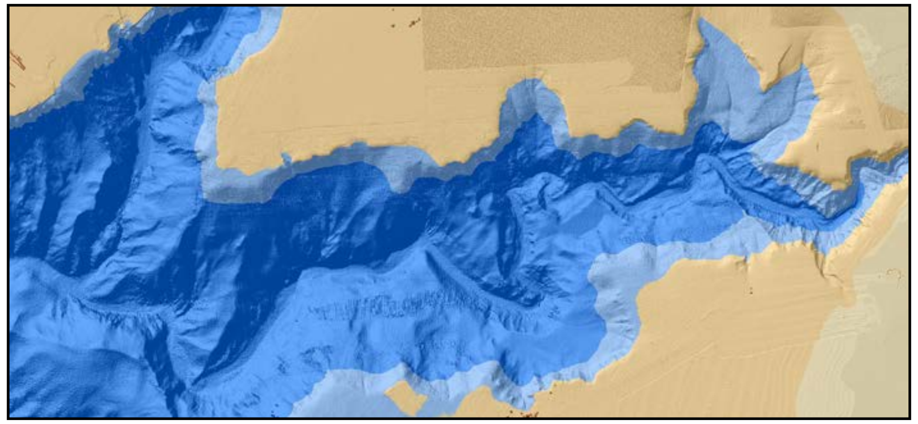


Species	MPA Fish abundance: Treating all rock as equal	Using CSMP habitat variables	Percent Deviation
Kelp Greenling	16,000	10,400	52%
Lingcod	1,200	600	68%
Olive rockfish	90,400	68,000	32%
Gopher rockfish	8,800	5,800	51%
Blue rockfish	228,600	157,200	45%
China rockfish	3,000	2,000	42%

Fish illustrations: Amadeo Bachar

MPA	Depth (m)	Size (km²)	CSMP data Coverage (km²)	Rock Predicted (%)	Rock Observed (%)	Sediment Predicted (%)	Sediment Observed (%)	Rippled Scour Depression (RSD) RSD (%)	Rippled Scour Depression (RSD) Non-RSD (%)
Ano Nuevo SMCA									
	0-30	22.4	15.9	41.2%	42.1%	58.8%	57.9%	0.1%	57.8%
	30-100	6.3	6.3	0.0%	32.8%	100.0%	67.2%	4.6%	62.6%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**28.7**	**22.2**	**28.4%**	**39.5%**	**71.6%**	**60.5%**	**1.3%**	**59.2%**
Greyhound Rock SMCA									
	0-30	8.0	5.8	58.2%	49.6%	41.8%	50.4%	0.0%	50.4%
	30-100	23.0	22.4	0.0%	0.4%	100.0%	99.6%	1.0%	98.6%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**31.0**	**28.2**	**10.4%**	**10.6%**	**89.6%**	**89.4%**	**0.8%**	**89.7%**
Soquel Canyon SMCA									
	0-30	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	38.4	38.2	15.3%	1.5%	84.7%	98.5%	0.0%	98.5%
	100-200	7.4	7.3	53.0%	4.0%	47.0%	96.0%	0.0%	96.0%
	>200	13.6	13.6	20.5%	0.0%	79.5%	100.0%	0.0%	100.0%
	Total	**59.4**	**59.2**	**22.4%**	**1.4%**	**77.6%**	**98.6%**	**0.0%**	**98.6%**
Portuguese Ledge SMCA									
	0-30	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	4.5	4.4	20.8%	10.8%	79.2%	89.2%	0.0%	89.2%
	100-200	14.5	14.6	26.7%	6.3%	73.3%	93.7%	0.0%	93.7%
	>200	8.6	8.5	51.5%	0.0%	48.5%	100.0%	0.0%	100.0%
	Total	**27.5**	**27.5**	**32.0%**	**5.1%**	**68.0%**	**94.9%**	**0.0%**	**94.9%**
Pacific Grove Marine Gardens SMCA									
	0-30	1.9	1.3	70.1%	57.8%	29.9%	42.2%	0.4%	41.8%
	30-100	0.5	0.5	89.7%	48.2%	10.3%	51.8%	0.1%	51.7%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**2.4**	**1.8**	**74.3%**	**55.1%**	**25.7%**	**44.9%**	**0.3%**	**44.6%**
Asilomar SMR									
	0-30	3.7	2.1	69.5%	58.7%	30.5%	41.3%	0.0%	41.3%
	30-100	0.2	0.2	90.4%	72.0%	9.6%	28.0%	6.2%	21.8%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**3.9**	**2.3**	**71.5%**	**59.9%**	**28.5%**	**40.1%**	**0.6%**	**39.5%**
Lovers Point SMR									
	0-30	0.8	0.5	36.2%	26.9%	63.8%	73.1%	6.1%	66.9%
	30-100	0.0	0.0	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**0.8**	**0.5**	**35.9%**	**26.9%**	**64.1%**	**73.1%**	**6.1%**	**66.9%**
Edward R. Ricketts SMCA									
	0-30	0.6	0.5	31.5%	17.9%	68.5%	82.1%	0.0%	82.1%
	30-100	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**0.6**	**0.5**	**31.5%**	**17.9%**	**68.5%**	**82.1%**	**0.0%**	**82.1%**
Carmel Pinnacles SMR									
	0-30	0.3	0.3	78.7%	86.8%	21.3%	13.2%	0.0%	13.2%
	30-100	1.0	1.1	84.4%	72.7%	15.6%	27.3%	0.0%	27.3%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**1.4**	**1.4**	**83.4%**	**75.8%**	**16.6%**	**24.2%**	**0.0%**	**24.2%**
Carmel Bay SMCA									
	0-30	4.1	2.8	42.8%	37.3%	57.2%	62.7%	0.5%	62.2%
	30-100	1.3	1.2	46.1%	25.9%	53.9%	74.1%	3.3%	70.8%
	100-200	0.2	0.2	0.0%	30.5%	0.0%	69.5%	0.0%	69.5%
	>200	0.0	0.0	0.0%	4.1%	0.0%	95.9%	0.0%	95.9%
	Total	**5.5**	**4.3**	**43.0%**	**33.2%**	**57.0%**	**66.8%**	**1.3%**	**65.5%**
Point Lobos SMCA									
	0-30	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	0.8	0.8	59.1%	72.5%	40.9%	27.5%	0.0%	27.5%
	100-200	9.6	9.6	35.8%	6.9%	64.2%	93.1%	0.0%	93.1%
	>200	11.6	11.5	27.5%	0.0%	72.5%	100.0%	0.0%	100.0%
	Total	**21.9**	**21.9**	**33.7%**	**5.6%**	**66.3%**	**94.4%**	**0.0%**	**94.4%**
Point Lobos SMR									
	0-30	4.2	2.2	61.3%	75.2%	38.7%	24.8%	0.0%	24.8%
	30-100	9.1	8.9	32.7%	40.3%	67.3%	59.7%	10.4%	49.3%
	100-200	0.8	0.9	3.6%	4.5%	96.4%	95.5%	9.3%	86.3%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**14.0**	**12.0**	**39.2%**	**44.1%**	**60.8%**	**55.9%**	**8.4%**	**47.5%**
Point Sur SMR									
	0-30	15.2	11.9	66.5%	45.9%	33.5%	54.1%	0.3%	53.7%
	30-100	10.0	10.0	43.5%	24.7%	56.5%	75.3%	7.5%	67.8%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**25.2**	**21.9**	**55.3%**	**36.2%**	**44.7%**	**63.8%**	**3.6%**	**60.2%**

MPA	Depth (m)	Size (km²)	CSMP data Coverage (km²)	Rock Predicted (%)	Rock Observed (%)	Sediment Predicted (%)	Sediment Observed (%)	Rippled Scour Depression (RSD) RSD (%)	Rippled Scour Depression (RSD) Non-RSD (%)
Point Sur SMCA									
	0-30	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	26.9	25.2	18.5%	11.2%	81.5%	88.8%	27.5%	61.2%
	100-200	0.6	0.5	73.7%	0.8%	26.3%	99.2%	0.0%	99.2%
	>200	0.0	0.0	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	Total	**27.5**	**25.9**	**18.6%**	**11.0%**	**81.4%**	**89.0%**	**27.0%**	**62%**
Big Creek SMCA									
	0-30	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	2.6	2.6	1.7%	0.8%	98.3%	99.2%	52.1%	47.1%
	100-200	1.8	1.8	12.6%	2.2%	87.4%	97.8%	0.0%	97.8%
	>200	15.9	15.9	0.3%	0.1%	99.7%	99.9%	0.0%	99.9%
	Total	**20.3**	**20.3**	**1.2%**	**0.3%**	**98.8%**	**99.7%**	**6.8%**	**92.9%**
Big Creek SMR									
	0-30	7.1	5.0	24.3%	14.0%	75.7%	86.0%	15.6%	70.4%
	30-100	8.4	8.4	4.0%	1.8%	96.0%	98.2%	23.0%	75.2%
	100-200	2.4	2.4	1.7%	0.9%	98.3%	99.1%	0.0%	99.1%
	>200	19.6	19.5	0.4%	0.1%	99.6%	99.9%	0.0%	99.9%
	Total	**37.5**	**35.2**	**4.9%**	**2.5%**	**95.1%**	**97.5%**	**2.7%**	**63.7%**
Piedras Blancas SMR									
	0-30	19.8	15.7	15.6%	40.2%	84.4%	59.8%	1.5%	58.3%
	30-100	7.2	7.2	5.5%	19.3%	94.5%	80.7%	4.5%	76.2%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**27.0**	**23.0**	**12.5%**	**33.6%**	**87.5%**	**66.4%**	**2.5%**	**63.9%**
Piedras Blancas SMCA									
	0-30	0.2	0.2	0.0%	88.3%	0.0%	11.7%	0.0%	11.7%
	30-100	22.7	22.4	6.4%	27.2%	93.6%	72.8%	2.8%	70.0%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**22.9**	**22.7**	**6.4%**	**27.2%**	**93.6%**	**72.3%**	**2.8%**	**69.5%**
Cambria SMCA									
	0-30	15.7	12.6	24.8%	30.4%	75.2%	69.6%	11.9%	57.7%
	30-100	0.4	0.4	0.0%	0.5%	100.0%	99.5%	61.9%	37.6%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**16.1**	**13.0**	**22.8%**	**29.5%**	**77.2%**	**70.5%**	**13.4%**	**57.1%**
White Rock (Cambria) SMCA									
	0-30	6.3	4.1	67.5%	57.5%	32.5%	42.5%	0.0%	42.5%
	30-100	1.3	1.3	2.2%	19.7%	97.8%	80.3%	2.0%	67.4%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**7.6**	**5.4**	**38.5%**	**48.4%**	**61.5%**	**51.6%**	**1.3%**	**50.3%**
Point Buchon SMR									
	0-30	4.3	2.8	42.5%	77.3%	57.5%	22.7%	1.5%	21.2%
	30-100	13.0	13.0	13.8%	9.4%	86.2%	90.6%	29.8%	60.7%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**17.3**	**15.8**	**17.2%**	**21.4%**	**82.8%**	**78.6%**	**24.8%**	**53.8%**
Point Buchon SMCA									
	0-30	0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	30-100	21.8	21.8	8.0%	3.8%	92.0%	96.2%	7.4%	88.7%
	100-200	9.7	7.9	0.6%	1.3%	99.4%	98.7%	0.0%	98.7%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**31.6**	**29.8**	**6.1%**	**3.2%**	**93.9%**	**96.8%**	**5.4%**	**91.4%**
Vandeberg SMR									
	0-30	58.0	48.9	10.9%	8.2%	89.1%	91.8%	0.1%	91.7%
	30-100	27.1	26.4	2.5%	0.8%	97.5%	99.2%	0.0%	99.2%
	100-200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	>200	0.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	**85.1**	**75.4**	**8.1%**	**5.6%**	**91.9%**	**94.4%**	**0.1%**	**94.3%**
All Central Coast MPA									
	0-30	172.5	132.7	29.0%	30.0%	71.0%	70.0%	2.1%	67.9%
	30-100	226.5	222.8	12.3%	10.9%	87.7%	89.1%	8.6%	80.5%
	100-200	46.9	45.2	28.7%	4.7%	71.3%	95.3%	0.2%	95.1%
	>200	69.3	69.1	13.9%	0.0%	86.1%	100.0%	0.0%	100.0%
	Total	**515.2**	**469.9**	**18.8%**	**14.1%**	**81.2%**	**85.9%**	**4.7%**	**81.2%**
Central Coast MLPA Region									
	0-30		723.0	17.6%	18.6%	82.4%	81.4%	3.6%	77.8%
	30-100		1546.4	6.6%	7.0%	93.4%	93.0%	9.9%	83.1%
	100-200		194.6	20.0%	2.4%	80.0%	97.6%	0.7%	96.9%
	>200		331.8	13.4%	0.2%	86.6%	99.8%	0.0%	99.8%
	Total		**2795.8**	**11.2%**	**8.9%**	**88.8%**	**91.1%**	**6.4%**	**84.7%**



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